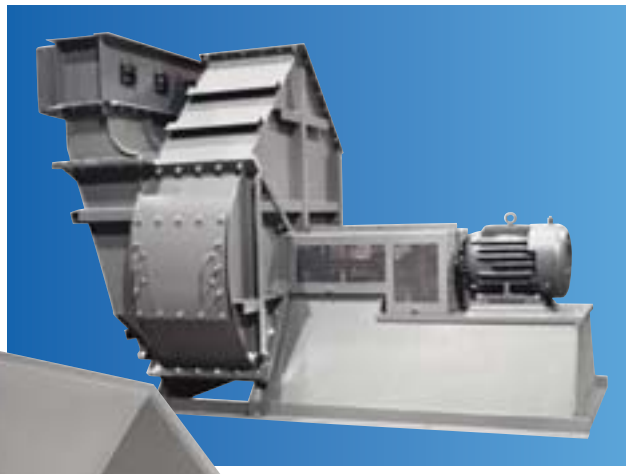
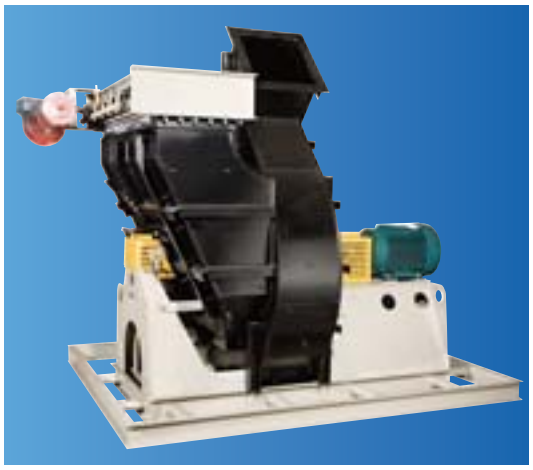
CHICAGO





Service Manual for Heavy Duty Fans

Safety
Installation
Operation
Maintenance

CHICAGO BLOWER CORPORATION • GLENDALE HEIGHTS, ILLINOIS • USA

CONTENTS

INTRODUCTION. **1**

INSTALLATION **2**

Unloading and Handling. 2
Foundations. 2
Duct Location and Design. 3
Fan Erection. 4
Housing Alignment 4
Pedestal Alignment 5
Rotor Assembly 5
Inlet Cone/Inlet Volume Control 5
Bearing Assembly and Alignment 6
Flexible Couplings 7
V-Belt Drive 9

ACCESSORY INSTALLATION. **10**

OPERATION. **11**

Vibration Limits 12

MAINTENANCE. **13**

TROUBLE-SHOOTING GUIDE. **14**

BEARING DETAIL. **16**

Dodge Sleevoil PLXC Bearings. 16
Dodge Sleevoil RTL Bearings. 18
Bearing Tables. 19
Solid Pillow-Block Bearings. 20
Split Pillow-Block Bearings. 22

RECORD of FAN INSTALLATION. **25**

WARRANTY. **25**

Air Movement and Control Association International

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www.amca.org

GENERAL INFORMATION

This manual is intended to aid in proper installation and operation of Heavy Duty fans manufactured by Chicago Blower Corporation (CBC). Due to the wide variety of arrangements and types of Heavy Duty fans, it is not intended to cover detailed installation procedures. Each purchaser of a Chicago Blower Heavy Duty fan is furnished with a detailed assembly drawing showing working conditions and a bill of material which is the Parts List. Any special features or installation requirements are described on this drawing to aid in proper installation and start-up. An operating performance curve is available through the CBC sales office which sold the equipment. A convenient Record of Fan installation is located on the inside back cover of this manual.

It is the responsibility of the purchaser to insure that installation and operation is handled by qualified personnel experienced in this type of equipment. Omission in this manual or on CBC assembly drawings of details, or operation methods commonly considered good practice by competent erection personnel, are not the responsibility of Chicago Blower Corporation.

A staff of trained field service and erection personnel is available from CBC to supervise installation or check alignment and balance at startup. Contact the Service Manager at CBC or your local CBC representative to arrange for this service.

SAFETY PRECAUTIONS

The fan you have purchased is a rotating piece of equipment that can become a source of danger to life, and can cause injury if not properly applied. **Maximum operating temperature and speed for which this fan is designed must not be exceeded.** These limits are given in our catalog, or in the order acknowledgement, or on Chicago Blower Corporation drawings.

Personnel who will operate this fan, or those who will perform maintenance thereon, must be given a copy of this manual to read, and be warned of the potential hazards of this equipment.

This manual contains general recommendations, but attention must also be paid to the specific safety requirements which apply to the individual installation. Such requirements are outlined in federal, state and local safety codes. Strict compliance with these codes, as well as strict adherence to installation instructions, are the responsibility of the user and are necessary to the safe operation of this fan.

The elements which connect the driving mechanism to the fan (V-belt drives or couplings) create potential DANGER to personnel and suitable guards must be provided.

Bearing assemblies and drive couplings must be covered so that no rotating element can snag clothing or skin. Shaft cooling wheels or any other rotating part must be covered. Any open sheave, pulley, sprocket, belt, chain, and other similar transmission device must be enclosed by guards.

Another potential hazard is the ability of the fan to convey loose material which can be a projectile. **Ducts must be protected to prevent objects from entering the airstream. Place suitable guards over inlets and outlets of fans to prevent the entrance of clothing or flesh into the rotating parts.**

Vibration limiting switches should be provided to detect sudden changes in the operation of the fan, especially when operating a fan under high temperature or in an extremely corrosive atmosphere.

The housing access doors must not be opened when the fan is in operation. Those on the discharge side of the fan can explode when unbolted.

Proper protection from electrical start of the fan during maintenance is required. **A disconnect switch provided with a padlock to prevent operation of the fan is required.** In addition, a disconnect switch should be located at the fan for use by personnel working on the fan.

RECEIVING and INSPECTION

Chicago Blower Corporation equipment is thoroughly inspected prior to shipment and, barring damage in transit, should be in good condition. All shipments must be carefully inspected by the Receiving Agent for damage. When a carrier signs Chicago Blower Corporation's bill of lading, the carrier accepts the responsibility for any subsequent shortages or damage; and any claim must be made against the carrier by the purchaser. Evident shortage or damage should be noted on the carrier's delivery document before signature of acceptance. Inspection by the carrier of damage, evident or concealed, must be requested. After inspection, contact the Chicago Blower Service Manager. A purchase order will be required for any part shortages. In the event of damage, a return materials authorization number will be assigned for the return of the equipment with Freight Prepaid. Damage assessment, and a repair price quotation will be provided once these parts have been received at Chicago Blower.

STORAGE PRECAUTIONS

If storage of equipment is necessary prior to erection, precautions must be taken to prevent damage. The rust preventative paint applied to the fan housing is sufficient in most environments. The rust preventative compound applied to machined surfaces by CBC, such as shafting, bearing pedestals and sole plates, is intended for in-transit protection only. If prolonged outside storage is necessary (more than two weeks), additional applications of rust preventative compounds, waterproof paper, tarpaulin or plastic covers are the responsibility of the purchaser. Covered equipment must be provided with moisture absorption material.

Motors, pedestals, dampers, shafts and bearings should be stored in a temperature controlled building to prevent deterioration prior to erection. Bearings received not mounted to the shaft should be stored in the original package and tightly sealed to prevent corrosion or buildup of foreign material during storage. In most cases, standard preparation for shipment by bearing, coupling and motor manufacturers is not sufficient for prolonged outdoor storage. If fan is provided with mounted grease lubricated bearings, lubricate the bearings with a premium quality NLGI2, lithium soap base, mineral oil grease upon receipt of fan. Add enough grease to cause a slight purge at the seals while rotating the shaft. This procedure must be done twice every month thereafter until the fan is placed in service.

If a rotor (wheel and shaft) is received as a separate assembly, block each end of the shaft to prevent sagging. When a wheel is located in a fan housing, the wheel must be rotated ten full revolutions approximately once every two weeks.

UNLOADING and HANDLING

⚠ **Chicago Blower fans must be handled and moved using good rigging techniques, being careful to avoid concentrated stresses that distort any of the parts.**

Rotor Assembly:

Many CBC Heavy Duty wheels are furnished as a rotor assembly complete with a shaft, and often with a shrink fit between wheel and shaft. This rotor assembly may be shipped on a fabricated steel cradle for ease of handling in shipment and unloading. Remove the rotor assembly from the cradle by placing slings around the shaft as close as possible to either side of the wheel. A spreader bar on the hoisting cables must be used to prevent damage to the wheel during lifting (See Figure 1). Do not use any part of the wheel rim for lifting purposes. Do not put the sling on portion of the shaft where the bearings will later be mounted. Rotors must never be lifted by the wheel, blades or sideplates, or allowed to rest on the ground without blocking the shaft ends. Wheels should never be rolled if lifting equipment is available. If rolling becomes necessary, extreme caution must be exercised to prevent damage. A wheel that has been knocked out of round must be rebalanced.

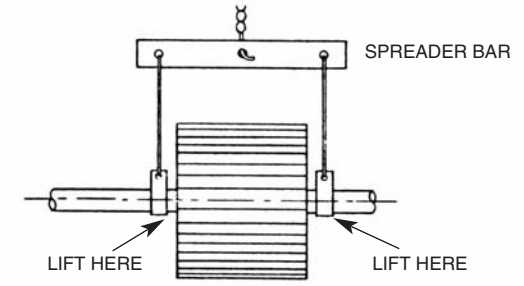


Figure 1

If the wheel is separate from the shaft, a wrapped sling or timber may be passed through the hub for lifting. Extreme care must be taken not to damage the finished bore of the hub, or the bearing and hub surfaces of the shaft.

Housing:

In unloading and handling large housing sections, an attempt should be made to lift from as many points as possible. Spreader bars must be used to prevent concentrated stresses that can collapse the housing and cause permanent distortion. Inlet box and outlet dampers must be handled with care, as distortion could cause binding during operation.

⚠ Fans covered with special coating or paint must be protected in handling to prevent damage. **Avoid nicks or cuts in the coating which may be difficult and expensive to repair.**

FOUNDATIONS

⚠ **A rigid, level foundation is a must for every fan.** It assures permanent alignment of fan and driving equipment, reduces excess vibration, and minimizes maintenance costs. The sub-foundation (soil, stone, rock, etc) should be firm enough to prevent uneven settlement of the structure. Foundation bolt locations are found on the assembly drawings.

Poured Concrete:

Reinforced pored concrete is the preferred foundation for Heavy Duty fans. The minimum design weight of a concrete foundation should be three times the total assembly weight of the fan and driver. This mass acts as an inertia block and will absorb any normal vibration that might develop, as well as hold the driver and fan in perfect alignment. It is preferred that the bottom of the base be larger than the top, with the degree of taper to the footing course dependent on the available sub-foundation. The edges of the foundation should be beveled to prevent chipping and should extend at least 6" beyond the fan structure. A minimum allowance of 1" should be made for shimming and grouting when the top level of the foundation is determined. (See Figure 2)

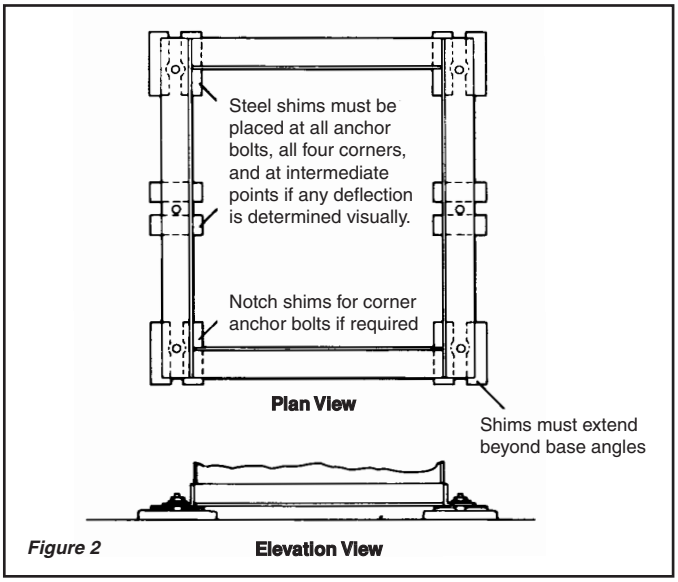

Steel shims must be placed at all anchor bolts, all four corners, and at intermediate points if any deflection is determined visually.
Notch shims for corner anchor bolts if required
Plan View
Shims must extend beyond base angles
Elevation View

Figure 2

Sole plates under the bearing pedestals and motor base plate, (See Figure 7, Page 5), are recommended for use on concrete foundations. Parts can then be removed without disturbing the cement or grout, making realignment easier.

"J" shaped hold down bolts should be used in the concrete (See Figure 3). They should be placed in a metal sleeve or pipe with a diameter 2-1/2 times the hold-down bolt diameter to allow minor adjustment after the concrete has cured. When determining the length of anchor bolts, allow 1" extra length for leveling and grout, flange thickness of the fan foundation, nut, washer, and extra threads for draw down. "J" bolts must be positioned so the bottom does not break out of the concrete.

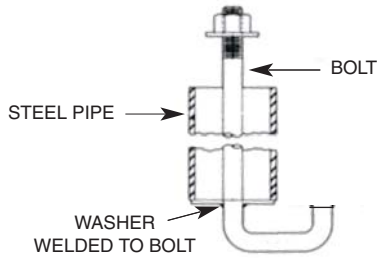


Figure 3

Structural Steel Foundations:

If the fan is mounted on equipment having parts which cause vibration, **it is very important that fan support be rigid enough to prevent such vibration from being carried to the fan.** The resonance frequency of this support must be a minimum of 25% above the maximum fan speed. ⚠

When a structural steel foundation is necessary, it must be sufficiently rigid to assure permanent alignment. It must be designed to carry, with minimum deflection, the weight of the equipment plus the loads imposed by centrifugal forces set up by the rotating element. In such cases, the design of the structure must permit field revisions (such as knee braces) if initial operation indicates a need for increased stiffness.

DUCT LOCATION and DESIGN

When locating the foundation, carefully plan the ducting or breaching to the fan to avoid possible air performance problems.

To deliver stable rated performance, fans require smooth, straight distributed flow into the inlet and straight flow out of the outlet for a distance of at least three duct diameters. Where duct turns or abrupt change in duct dimensions are necessary within three duct diameters of fan outlet, flow distributing devices (turning vanes) must be installed (See Figures 4 and 5). Where these means are impractical, such as close to the fan outlet, the amount of fan performance loss can be found in AMCA Publication 201 (see front cover for address). Care must be taken to prevent spiral or vortex flow into fan outlet since these flow conditions frequently cause pulsation or unstable delivery. Contact your local Chicago Blower sales office for further information. (See back cover)

Duct Connections:

⚠ **Flexible connections and/or expansion joints must be provided at fan inlet and outlet** to isolate the fan from duct static loads, duct temperature expansion loads and from vibration loads. Flexible connections may be multiple bellows expansion joints, banded slip joints, or fabric or sheet plastic flexible joints. Flexible connections may require acoustic treatment to reduce noise radiation. Ducts must be separately anchored near the fan.

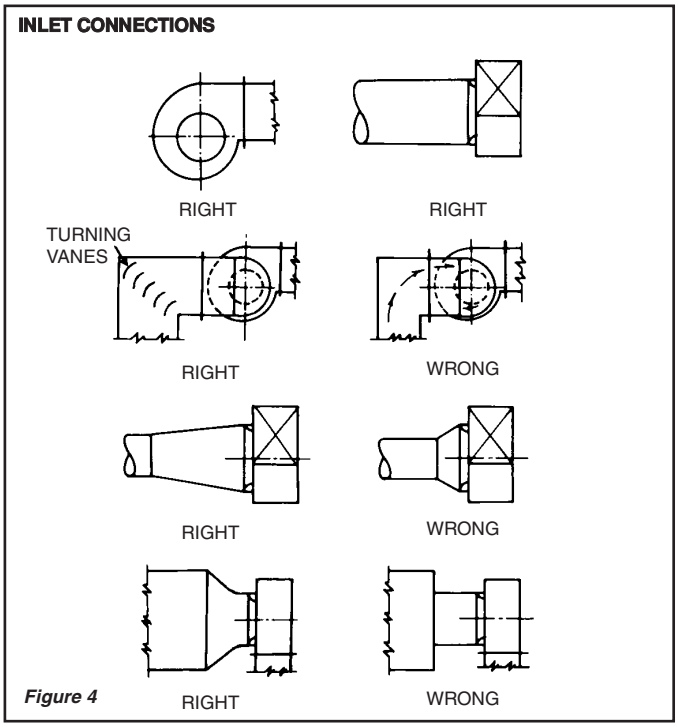


Figure 4

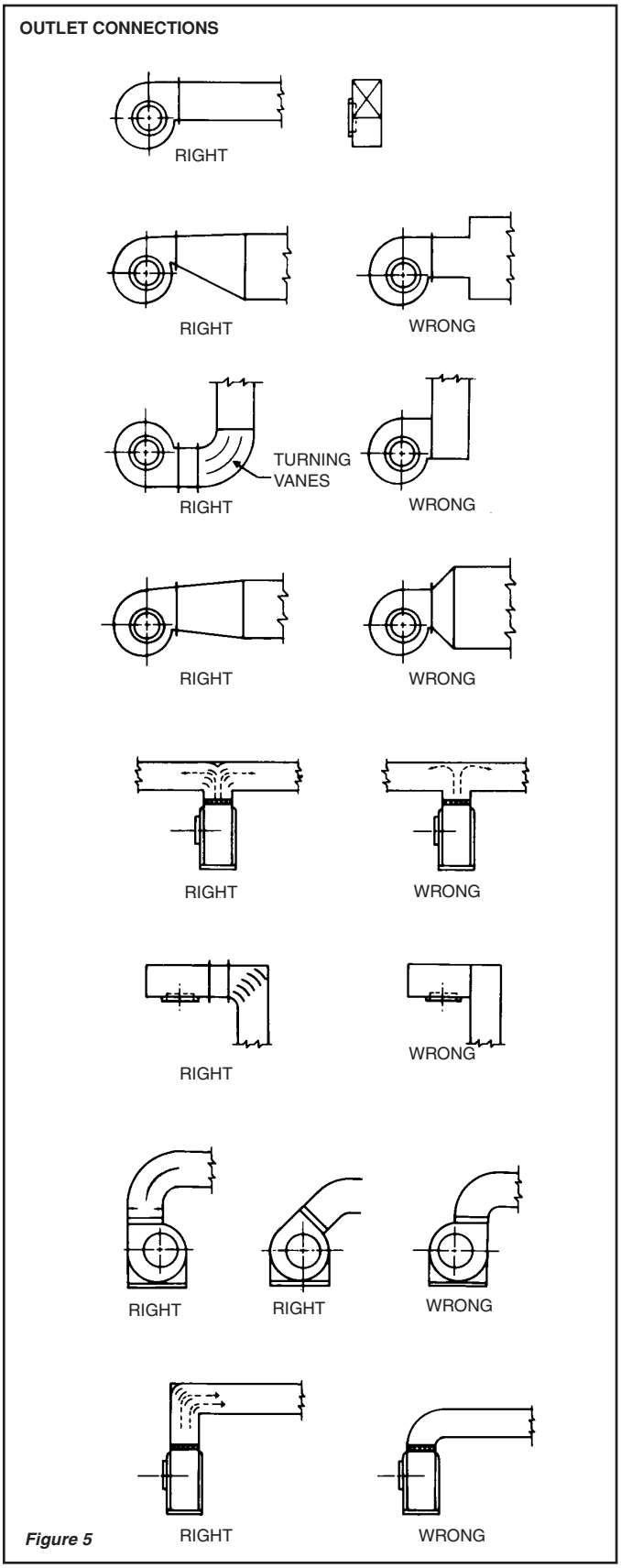


Figure 5

FAN ERECTION

Erection as covered in this section, specifically covers Arrangement 3-SISW and 3-DIDW fans with independent pedestals. Although the procedure for installing A/1, A/4, A-7 and A/8 fans differs slightly, they are generally less complicated to install and incorporate simple modifications of some of the steps outlined. See Figure 6.

For Arrangement 1, 7 and 8 fans, level shaft between bearings. Shim under base to attain level. Tighten foundation hold-down bolts. Some fans with disjointed bases are shipped from the factory with "shipping clips" (bars holding the fan housing and pedestal together). **DO NOT REMOVE THESE CLIPS UNTIL GROUTING IS COMPLETE.** Always remove these clips before operating the fan.

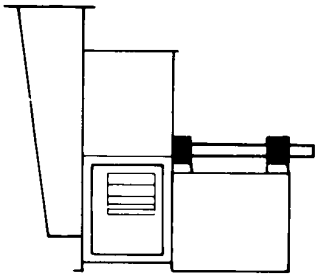
For fans with independent pedestals, proceed as follows:

Set and Align Housing on Foundation:

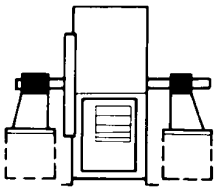
If the housing was shipped knocked down, the bottom half must be lifted onto the foundation first. Place wooden blocks beside the anchor bolts to prevent damage to them while the housing is being moved into proper position. The housing should be lifted from as many points as possible. The use of spreader bars will help minimize distortion. When the housing is properly aligned over the anchor bolts, it should be lifted up one side at a time, the block removed, and the housing lowered carefully onto the foundation. Permanent shims approximately the same size as the grout should be placed on either side of each anchor bolt. The shims should extend beyond the edge of the base angle and should be approximately 4" wide. These shims will give the housing good support and prevent it from slipping when the anchor bolts are drawn down. See Figure 2, Page 2.

DRIVE ARRANGEMENTS FOR CENTRIFUGAL FANS

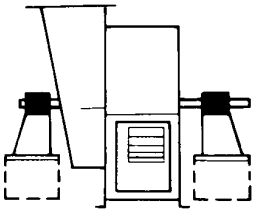
SISW – Single Inlet, Single Width
DIDW – Double Inlet, Double Width



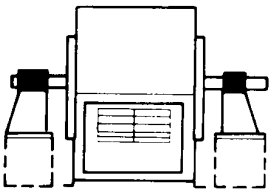
ARR. 1 SISW With Inlet Box For belt drive or direct connection. Impeller overhung, two bearings on base. Inlet box may be self-supporting.



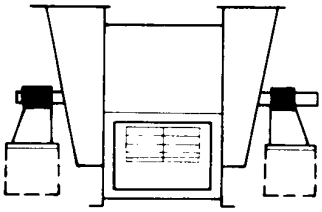
ARR. 3 SISW With Independent Pedestal For belt drive or direct connection. Housing is self supporting. One bearing on each side supported by independent pedestals.



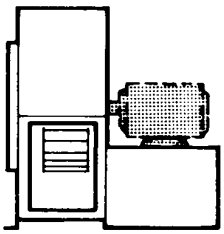
ARR. 3 SISW With Inlet Box and Independent Pedestals For belt drive or direct connection. Housing is self supporting. One bearing on each side supported by independent pedestals with shaft extending through inlet box.



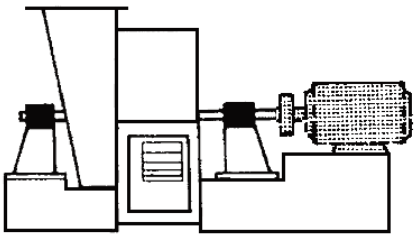
ARR. 3 DIDW With Independent Pedestal For belt drive or direct connection. Housing is self supporting. One bearing on each side supported by independent pedestals.



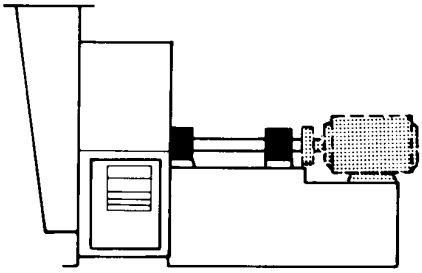
ARR. 3 DIDW With Inlet Box and Independent Pedestals For belt drive or direct connection. Housing is self supporting. One bearing on each side supported by independent pedestals with shaft extending through inlet box.



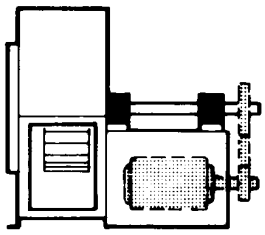
ARR. 4 SISW For direct drive. Impeller overhung on prime mover shaft. No bearings on fan. Prime mover base mounted or integrally connected.



ARR. 7 SISW With Inlet Box For direct connection. Arrangement 3 plus base for prime mover.



ARR. 8 SISW With Inlet Box For direct connection. Impeller overhung, two bearings on base plus extended base for prime mover. Inlet box may be is self supporting.



ARR. 9 SISW For belt drive. Impeller overhung, two bearings, with prime mover outside base.

Figure 6

Set and Align Bearing Pedestals:

The bearing soleplates and pedestal assembly should be put in place, using shims to approximately the bearing centerline height as shown on the fan assembly drawing. The fixed bearing must be leveled at this time using flat shims under the sole plate. Approximately 1/8" should be allowed for shimming between pedestal top and bearing for possible future alignment problems caused by settling of the foundation. In leveling the sole plate, adjusting nuts on the "J" bolts are helpful but after final alignment, hard shims must be placed next to each "J" bolt and under the center of the sole plate before grouting. See Figure 7. Note the pedestal can be removed from the side without disturbing foundation bolts. Use the same procedure to align the floating bearing.

On top of the pedestal, shims running the full length and half the width of the bearing foot, slotted to fit around the foundation bolts, provide the most solid mounting arrangement for later mounting the bearings. Temporarily bolt down bearing pedestals.

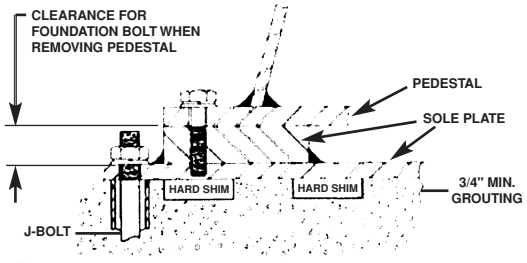


Figure 7 **Section view showing pedestal, sole plate and grouting.**

Prepare Rotor Assembly:

All Chicago Blower Corporation Heavy Duty wheels are shipped with a shrink fit or slip fit to the shaft. Check for proper wheel rotation with the rotation arrow on the drawings, on the fan, or the diagrams in Figure 8.

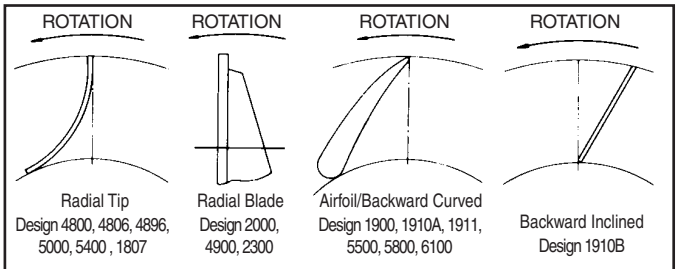

ROTATION
ROTATION
ROTATION
ROTATION
Radial Tip Design 4800, 4806, 4896, 5000, 5400 , 1807
Radial Blade Design 2000, 4900, 2300
Airfoil/Backward Curved Design 1900, 1910A, 1911, 5500, 5800, 6100
Backward Inclined Design 1910B

Figure 8 **Direction of Rotation for Various Blade Shapes (shown for counterclockwise from drive side)**

For wheels shipped separate from shafts:

Carefully place the wheel on the floor and brace in position. Remove any protective coating from the shaft and hub. Check for rust, corrosion and nicks. If cleanup is necessary, **DO NOT USE EMERY CLOTH** on any bearing surface. Crocus cloth may be used if necessary. Clean the shaft portion that fits into the wheel, as well as the wheel bore itself. Remove all keys and loosen set screws. Check fan assembly drawing for location of wheel on shaft. **Rotation is as viewed from the non-inlet side. On dual drive or double inlet units, it is generally from the "fixed" bearing end. Refer to general assembly drawing.**

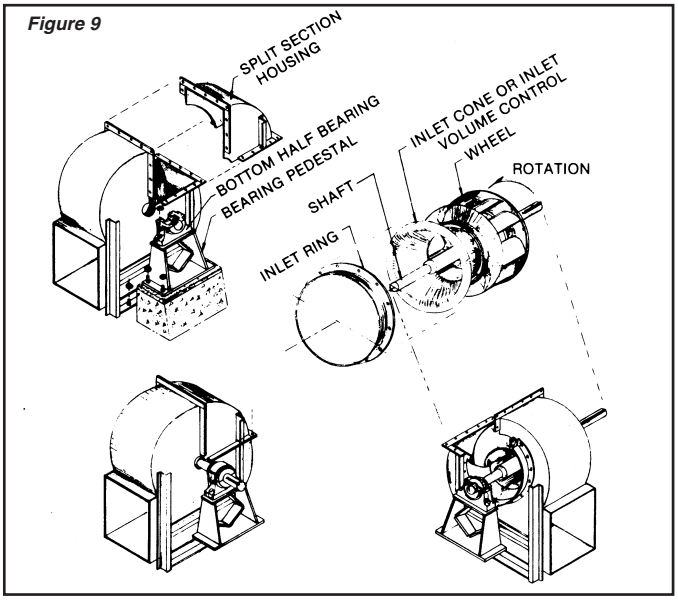
On a wheel and shaft with a clearance fit, lift shaft using padded slings. Carefully slide end into wheel hub and push through until wheel is properly located on shaft as shown on the assembly drawing. Extreme care must be taken not to damage wheel bore or shaft seal. Set keys in position and tighten set screws just enough to hold wheel on shaft during handling. Tighten fully when clearances have been set. See Table I.

Table I

Wheel Set Screws Square Head		Wheel Set Screws Allen Head	
Socket Size	Torque in/lbs	Socket Size	Torque in/lbs
1/4"	66	1/8"	66
5/16"	136	5/32"	136
3/8"	239	3/16"	239
7/16"	384	7/32"	384
1/2"	586	1/4"	586
5/8"	1163	5/16"	1163
3/4"	2076	3/8"	2076
7/8"	1992	7/16"	1992
1"	3000	1/2"	3000

On a rotor with a factory shrink fit, the preparation of the rotor assembly is limited to cleaning the shaft for installation.

Figure 9



Set Inlet Cone, Ring, or Inlet Volume Control

At this time, the Inlet Cone and retaining rings (or Inlet Volume Controls, if furnished) are placed over the shaft end for mounting the rotor assembly in the housing. See Figure 9. If inlet volume controls are provided, check for proper rotation. See Figure 10. Inlet vanes in the half closed position must pre-spin the air in the direction of wheel rotation. On a DIDW fan, one inlet vane control is clockwise and the other counter-clockwise. **Do not install them reversed.** Secure inlet vane controls to wheel for lifting purposes. Do not allow vane center mechanism to rest on shaft as damage will result.

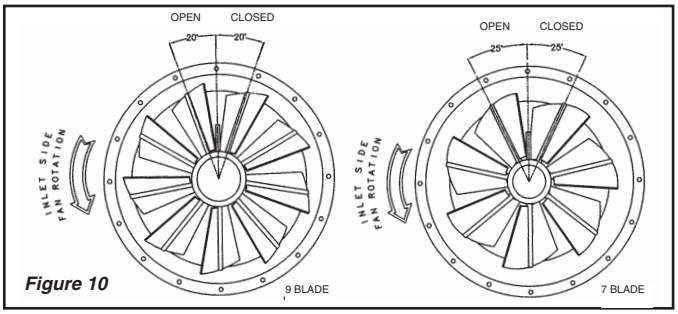


Figure 10

Prepare Bearings, Set Rotor Assembly:

1. For Sleeve Bearings:

Remove bearing caps and clean bearing housings and liners with solvent. Coat with clean oil and cover to avoid contamination. Clean oil rings and **shaft seals. Do not mix parts between the bearings as they are not interchangeable.** Bolt the lower half of the bearing housings loosely in place. Again cover to prevent contamination. Sling the rotor assembly as previously described. Lower the rotor assembly into the bearing housing. **For further information refer to Sleeve Bearing Detail Section, Page 16.**

2. For Anti-friction Bearings–Solid Pillow Blocks:

Non-split pillow blocks are slipped over the shaft ends prior to putting the rotor in place. Check to insure that the floating bearing (unless specified on the assembly drawing) is on the side opposite the driver. See Figure 12. Bolt bearings loosely on the pedestals. For further information, see Page 20.

3. For Anti-friction (Roller) Bearings–Adapter Mount, Split Pillow Blocks:

Cleaning of the internal parts should not be required as the corrosion preventative compound applied by the manufacturer is compatible with recommended lubricants. Careful inspection of all internal parts is good practice, as any corrosion present is likely to cause problems at a later date. **Do not mix housing parts between bearings as they may not be interchangeable.**

The bottom half of the pillow block is loosely bolted in place on the pedestals. Pillow blocks and bearing parts exposed to atmosphere must be covered with a clean cloth to prevent contamination.

The internal parts of the bearing are placed on the shaft ends in the same order that they were removed from the pillow block. See Figure 13. Sling the rotor assembly as described previously and lift into place. Put bearing caps in place to prevent contamination prior to final alignment. For further information, see Page 22.

Align Rotor and Housing

As a first step to proper alignment, level the drive side bearing. The floating bearing will later be shimmed to account for the shaft deflection. See Figure 11A. In leveling the bearing, see that the shaft centerline is the proper height for connection to the driver. After shimming of the drive bearing is complete, it should be drawn down. The floating bearing should be shimmed to take up the shaft deflection and should be drawn down in conjunction with the alignment of the inlet cone or inlet volume control.

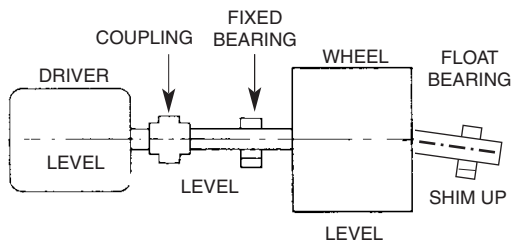
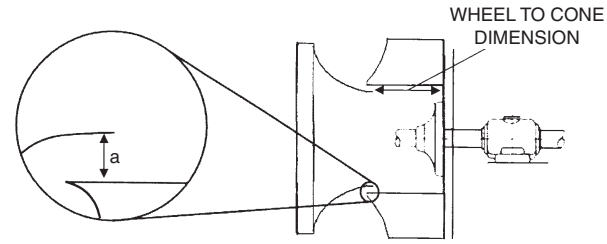


Figure 11A

Wheel to cone alignment details are included on the assembly drawing provided with each fan. The drawing gives a dimension for the inlet cone to wheel backplate distance. Check this alignment before final tightening of pedestals, bearing bolts and bearing locking devices. See Figure 11B

Figure 11B



Wheel to cone fit. Clearance (a) should be uniform all around inlet cone at fan installation for ambient air fans. See fan assembly drawing for clearance on ID or hot fans.

Adjustments for Expansion

Induced Draft Fans, or other high temperature applications, require wheel and cone adjustments for expansion due to temperature. This is because the housing expands up from the foundation while the rotor expands concentrically from the shaft centerline as well as axially from the fixed bearing. The following rules of thumb should be used on applications in excess of 300°F.

1. Axial over lap on double width fans should be approximately twice as much on the drive side as on the floating side.

2. Radial clearance between the wheel and inlet cone(s) should be twice as much at the top as at the bottom.

For induced draft fans or other high temperature applications over 300° F., care should be taken to duplicate exactly the wheel to cone clearances recommended on the assembly drawing. Cold settings are shown on the assembly drawing.

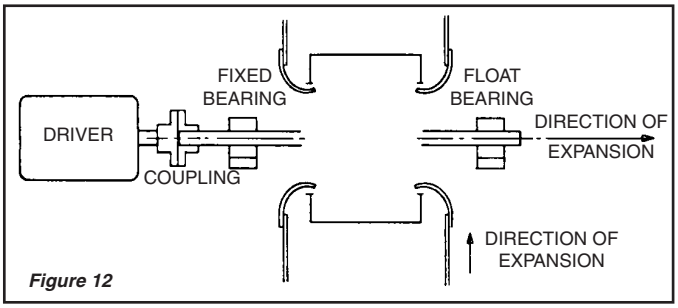


Figure 12

Set and Align Bearings

Setting of the drive side bearing level with the driver and aligning the outboard bearing have been mentioned previously. It is preferable that the drive bearing be set level to facilitate alignment of the driver, which is also set level. Any shaft deflection caused by suspension of the rotor weight between the bearings must be accounted for in the outboard bearing by placing shims under it. See Figure 11A. Shaft level is placed on the shaft at the journals and compared to the machined surface of the bearing housing until an equal slope is achieved.

Align Inlet Cones or Inlet Volume Controls

After the alignment of the rotor assembly, coupling and drive is complete, **the inlet cones or IVCs should be repositioned to provide proper clearance.** Center the cones on the inlet eye of the wheel. At this time the IVC linkage should be assembled as required. Details of linkage arrangement are supplied on the fan assembly drawing. Install gasketing in housing split. Apply caulking on the lower side to hold the gasket material. Then install the

split portion of the housing. Allowance must be made for expansion when operation is to be at elevated temperature. (Refer to the assembly drawing.) Tighten all fasteners in foundation, pedestals, etc. that were previously left loose. Install shaft seals if supplied. Turn rotor by hand to make sure it runs freely.

1. Dodge Sleeve Bearings

The elliptical shape of sleeve bearing liners makes lining up the bearings square with the shaft relatively simple. When the shaft rests in the liners, there is clearance on both sides the full length of the liners. In squaring up the bearings, a .0015 or .002 shim should be able to run the entire length of the liner at a fixed depth.

After alignment, install oil rings. Sizes up to 3-7/16" have a single ring; 3-15/16" and up, double rings. Tighten set screws on the rings and be sure that the rings rotate freely on the shaft. Run dust seal into its groove in the housing and fasten ends together. Next, apply a coating of oil on the upper portion of the liner and put in place. Place cap on bearing and tighten stud nuts. **The plunger screw must be loose before the stud nuts are tightened.** Detail instructions on sleeve bearing assembly can be found in the Bearing Detail Section, Page 16.

2. Solid Pillow Block Spherical Roller and Ball Bearings

Slide, tap or press bearings on shaft. Establish final shaft position and tighten bearing to support. Position locking collar and torque CBL Grade 2 set screws to the bearing manufacturer's recommended torque values. See bearing assembly instructions in Bearing Detail, Page 20.

3. Split Pillow Block Spherical Roller Bearings

The lower half of the pillow block should be bolted loosely to the pedestal. After assembling bearing parts on the shaft in the same order as Figure 13, hand tighten the adapter assembly. Be sure that the bearing is properly positioned on the shaft before tightening to the proper clearances. The space in the expansion or floating bearing should always be on the outboard side or side away from the drive (coupling) bearing. See bearing assembly instructions in Bearing Detail section, Page 22.

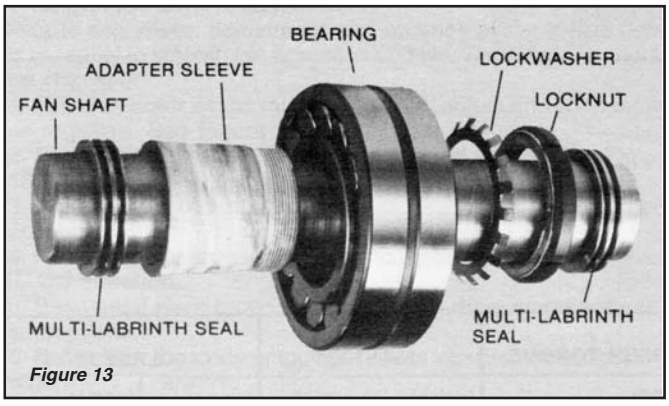


Figure 13

Flexible Coupling Installation and Alignment

These instructions cover, in general, the installation of flexible couplings of the pin, gear, or grid types.

1. Before mounting coupling(s), be sure all bearings, inlet vane(s), etc. have been installed.

2. Install each coupling half-cover with "O" ring on its shaft.

3. Determine which direction, long or short, shank of coupling hub should be located. See manufacturer's manual.

4. Heat coupling hub to approximately 300°F by means of hot oil bath or oven. **Do not apply flame to hub teeth.**

5. Install coupling hub(s) on shaft. See customer drawing for position.

6. Key the couplings to the shafts while the hub(s) are still hot.

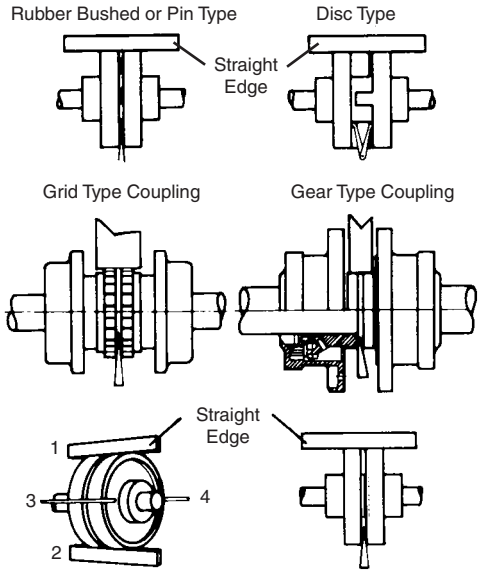
7. Adjust the clearance between the coupling faces. The proper clearance dimension is listed on the assembly drawings and included in manufacturer's information. This dimension may also be stamped on the coupling hubs.

8. When a sleeve bearing is used, locate it so that when the motor rotor is closest to the fan, the motor shaft will not touch the fan shaft. If the motor shaft has its magnetic center marked, align it in this position. Otherwise equally divide the maximum play to obtain the mechanical center. Align in this position

9. With tapered wedge, feeler gauges, dial indicator, or laser, observe that the faces of the fan and driver couplings are parallel.

10. Align the shafts until a straightedge appears to be parallel to the shafts. Repeat at three additional points at 90° from each other. Recheck angular alignment and hub separation. (See Figure 14)

Coupling Alignment



Check all types at four positions 90° apart as shown

Figure 14

11. For more accurate alignment, use a dial indicator clamped on one hub, with the dial indicator button resting on the other hub. Rotate the hub on which the indicator is clamped, and observe the indicator reading. Take readings at four locations, 90° apart. With correct alignment, the faces of the couplings should be parallel within .001 per inch of shaft diameter, in both parallel and angular planes. (See Figure 15) If available, laser alignment is recommended.

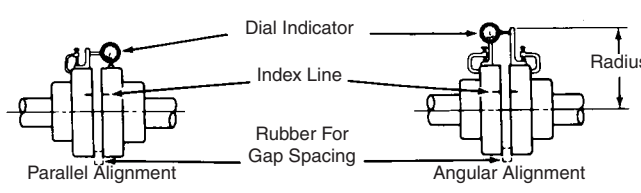


Figure 15

12. Where large turbines or motors are used as drivers, the driver side of the coupling should be set low by a few thousandths to allow for the driver to heat up during operation when it will expand and bring the coupling into alignment. A rule of thumb for initial alignment of a large motor is: Set driver low .001" for each 1" of shaft diameter; i.e 1" shaft motor low by .001", 2" shaft motor low by .002. Set turbines low by .001" per inch of turbine height from mounting feet to centerline of shaft. After unit has operated and thermal expansion is complete, coupling alignment should be checked and corrected if necessary.

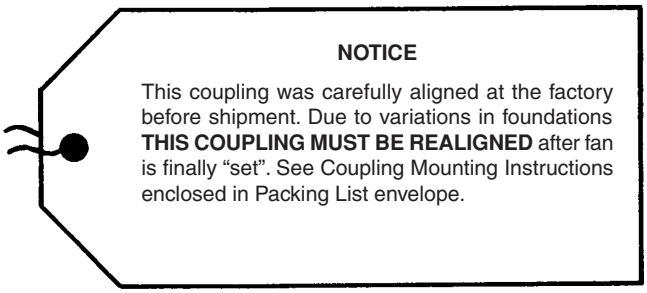
13. After completing the coupling alignment, clean both sides of the coupling thoroughly, and inspect the gasket for tears, cracks or other damage.

14. Install the gasket between the coupling halves. Draw the coupling flanges together keeping gasket holes in line with bolt holes. Insert and tighten bolts, lockwashers and nuts.

15. Lubricants formulated for couplings are available from the specific coupling manufacturer; ie Falk's LTG (Long Term Grease) or Kopflex's KSG or KHP. Both are NLGI Grade #1/#2 Grease. If unavailable lubricate in accordance with type of operating conditions shown in Table II.

SPECIAL NOTE ON ALIGNMENT:

On any completely assembled fan, where CBC has mounted the motor and coupling, it is required that the alignment be rechecked after the fan is set on its permanent foundation. It is not possible to hold alignment during shipment or when set on a different foundation. Alignment must be within specifications and the coupling lubricated. A tag is attached to the coupling guard warning installer of re-alignment requirement.


NOTICE
This coupling was carefully aligned at the factory before shipment. Due to variations in foundations **THIS COUPLING MUST BE REALIGNED** after fan is finally "set". See Coupling Mounting Instructions enclosed in Packing List envelope.

The lubricants listed below are recommended by the lubricant manufacturers for the indicated conditions. This list is solely for our customers' convenience and does not constitute an endorsement. This listing is not intended to be complete nor necessarily current due to continuous research and improvement by the various manufacturers.

Table II – COUPLING LUBRICANTS

LUBRICANT MANUFACTURER	GENERAL	MOIST OR WET	HIGH TORQUE	150°-300°F	CLASS III
American Lubricants **Atlantic Richfield** **Amoco**	Alubco Bison 1650 Arco MP Amolith #2	(same) Arco MP Amolith #2	(same) Arco EP or Moly D Amolith #2	(same) Dominion H2 Rykon EP-2	(same) Dominion H3 Amoco CPLG Grease
Chevron USA. **Cities Service**	Duralith EP-2 Citgo AP or HEP-2 ——	Duralith EP-2 Citgo AP or HEP-2 ——	Duralith EP-2 Citgo AP or HEP-2 ——	Duralith EP-2 Citgo AP or HEP-2 ——	NL Gear Compound 460 Citgo AP or EP Compound 130
Continental . **Far Best**	Super Sta Grease —— Molyvis ST-200	HD Calcium Grease —— (same)	HD Calcium —— (same)	HD Calcium —— (same)	HD Calcium, Transmission Oil No. 140 None
Fiske Bros. Refining **Gulf Oil** **Exxon**	Lubriplate 630-AA Gulfcrown EP #2 Pen-O-Lead EP 350	Lubriplate 630-AA Gulfcrown EP #2 Rolubricant EP 300	Lubriplate 630-AA Gulfcrown EP #2 Rolubricant EP 350	Lubriplate 1200-2 Hi-Temp Grease Unirex N2	Lubriplate No. 8 Precision No. 3 Unirex N2 or Nuto 146
Kendall Refining **Mobil Oil**	Kenlube L-421 or Waverly Torque Lube A Mobilux EP-O	L-421 or Torque Lube A —— Mobilux EP-O	L-421 or Torque Lube A —— Mobilux Temp 78	L-421 or Torque Lube A —— Mobilux Temp 78	L-421 or Torque Lube A —— Mobilux No. 28
Pennzoil **Suntech**	Pennlith 711 or 712 —— Sunaplex 991 EP or Prestige 741 EP	Pennlith 711 or 712 —— (same)	Pennlith 711 or 712 —— (same)	Pennlith 712 or Bearing Lube 706 (same)	Hi Speed Pennlith 712 or Bearing Lube 706 ———
Syn-Tech **Tenneco Chemicals** **Texaco** **Union Oil Co. of Calif.**	3913-G1 Anderol 786 Multifak EP-2 UNOBA EP-2	(same) (same) Multifak EP-2 UNOBA EP-2	(same) (same) Multifak EP-2 UNOBA EP-2	(same) (same) Thermatex EP-2 UNOBA EP-2	(same) (same) Thermatex EP-2 MP Gear Lube 140

For low temperatures (-65°F), Aeroshell #22 by Shell Oil Co., Anderol 793 by Tenneco Chemicals, Inc., and Mobil Grease #28 by Mobil Oil Co.

V-Belt Fan Drive Arrangement

Proper alignment, adjustment and balance of the V-Belt drive is essential to smooth operation and long life. The following should be checked:

1. Fan and motor shafts must be parallel. Adjust and shim motor as required. See Figure 16.

2. Fan and motor sheaves must be aligned axially. See Figure 16.

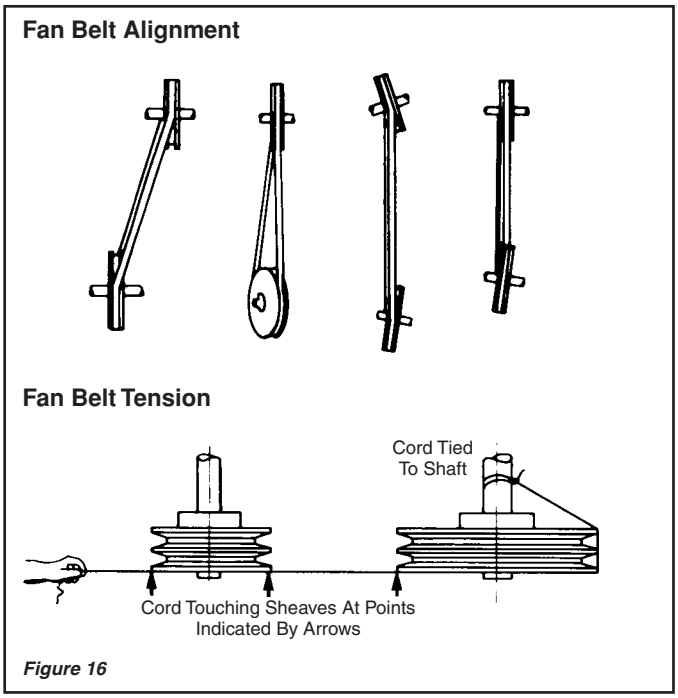


Figure 16

3. Adjustable motor sheave grooves must have no noticeable eccentricity.

4. Fan and motor sheave balance should be checked when there is any vibration.

5. Belts must have proper tension. Follow drive manufacturer's instructions.

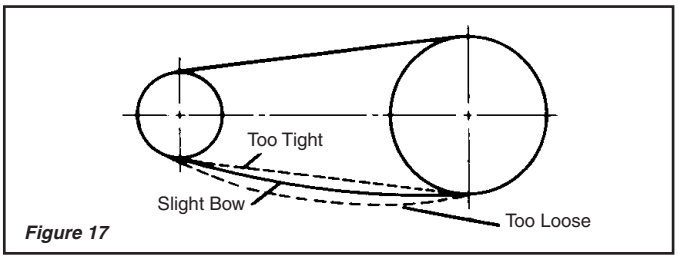


Figure 17

6. Belts either too loose or too tight cause vibration and excessive wear. See Figure 17.

7. For field erected fans, position the sheaves and belts as close to the bearing base as possible.

Belt Tension Adjustment

Step 1: With all belts in their proper grooves, adjust the centers to take up all slack and until the belts are fairly taut.

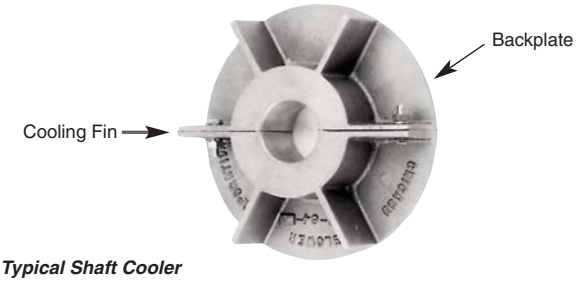
Step 2: Start the drive and continue to adjust until the belts have only a slight bow on the slack side of the drive while operating under load. If belts squeal at startup, they are too loose. Correct tension is just enough to prevent squealing. See Figure 17.

Step 3 After a few days operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight "bow" in the slack side. The drive is now properly tensioned and should operate satisfactorily with only an occasional readjustment to compensate for belt and groove wear.

Grouting Unit

After completion of all installation and alignment procedures, **it is recommended that a Chicago Blower Corporation Service Engineer check the installation** prior to grouting. This service is available on a daily fee plus expenses basis through your CBC local sales office or the Service Manager at CBC. After verification of alignment, grouting can be completed. There are a number of commercial non-shrinking grouts available, such as 5 Star grout having aluminum chips or Embaco with steel chips. Allow 72 hours after grouting before startup.

Shaft Coolers are typically split cast aluminum radial bladed wheels designed to dissipate heat conducting down the shaft toward the bearings. The two halves are bolted together around the fan shaft with the backplate toward the fan housing and the cooling fins drawing air over the bearings. Some shaft coolers have a straight bore and are not split. Set screws hold these coolers to the shaft. Consult the assembly drawing for proper location. **An expanded metal guard must be installed over cooling wheels.**



Typical Shaft Cooler

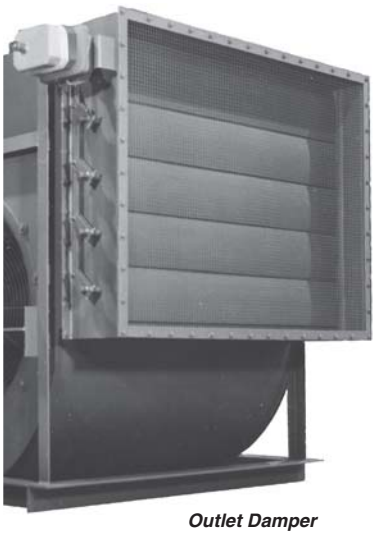
Standard CBC Shaft Seals are compressed fibrous material. Split seals are furnished as standard on most fans, both on the inlet box and drive sides of the fan. This seal is clamped in place by a split metal retainer plate. These seals are not gas tight.

Inlet Volume Controls (IVC) are inlet cones with variable inlet vanes mounted in them to regulate fan volume and power. On double inlet units, interconnecting linkage assures simultaneous operation. See Figure 10, Page 5 on how to check that the vanes are spinning the inlet air in the direction of wheel rotation. Linkage assembly details are provided on the fan assembly drawing. IVCs are furnished for manual operation with a locking quadrant or for automatic operation using an electric or pneumatic actuator.

Inlet Volume Control

Prespin Inlet Box Dampers are provided for volume control and power savings similar to that achieved with the IVC. The damper comes in a separate channel steel frame with damper axles running parallel to the fan shaft. The damper blades are double surface and when partially closed, the blades prespin the air in the direction of wheel rotation. Units operating in excess of 200°F are provided with flanged ball bearings mounted on stand-off channels and cast stuffing boxes containing braided fibrous packing to prevent leakage. For units shipped knocked down, or DIDW units, detailed linkage mounting information is on the fan assembly drawings. At installation, make sure they prespin the air in the direction of wheel rotation. See Figure 18, Page 11.

Note: Some fans are provided with fresh air, opposed bladed inlet box dampers. These are typically used when recirculated flue gas is introduced back into the fan's inlet airstream. These dampers are located above the FGR connection.



Outlet Damper

Prespin Inlet Damper

Outlet Dampers are mounted in a separate channel frame and bolt to the discharge outlet of the fan for volume control. The damper blades are double surface and are opposed blade. Dampers operating in excess of 200°F are provided with flanged ball bearings mounted on stand-off channel and cast stuffing boxes with braided fibrous packing to prevent leakage.

Note: On high temperature dampers (above 300°F), the set screws should not be tightened in the damper axle bearings on the side opposite the operating linkage. This allows the damper shaft to expand away from the locked bearings on the linkage side.

Damper Inspection. Whether damper is received installed on the fan or shipped separately, check all the levers, linkage and blade hardware to be sure that they are secure. Operate the control handle manually to check that all the blades are operating freely, open fully and close tightly.

Damper Installation. When installing dampers in the field, refer to the assembly drawing to assure that damper linkage is in the proper position and the blades rotate from closed to open position in the correct rotation. **Desired fan performance may not be obtained if proper blade rotation shown on drawing is not observed.**

Double width fans using two dampers operate with a single control arm and a shaft connecting the two dampers. **Blades in both dampers must fully open and close together.** The connecting shaft often is in two pieces, and although a set screw is provided in the coupling as an aid for assembly, **this section should be field welded to the shaft after the damper blades are synchronized.** Fans operating at higher temperatures have shaft coupling arrangements to provide for expansion. Do not weld both ends to the shaft.

Do not insulate dampers having ball bearings, if above 180°F. Do not enclose exposed shaft and bearings in a manner that would restrict natural cooling by ambient air.

INITIAL STARTUP

In the event that startup service and a vibration survey is not purchased from CBC, the following general check lists should act as an aid. It is not intended to cover all contingencies and it is assumed that the installing contractor is experienced with this type of equipment, and will follow all good initial startup procedures.

FAN OPERATION

Equipment must be installed in accordance with CBC instructions and those of the manufacturers of components, and a check must be made for tightness of all hardware and mounting bolts. The fan will then be ready to operate after final safety checks to prevent injury to personnel or damage to the equipment.

1. Lock out power source.

2. Check bearings for alignment, proper lubrication, tolerance, locking collars tight, cleanliness, burrs and corrosion. Check water connections for cooling, if required.

3. Check keys and wheel set screws for tightness and proper torque. Check foundation bolts for tightness.

4. Check inside of housing and duct work for extraneous matter and debris. Secure all access doors.

5. Check wheel position for proper clearance at inlet.

6. Turn wheel by hand, if possible, to see that it rotates freely.

7. Close Inlet Volume Control and/or dampers to lessen starting load on driver.

8. Supply water to water cooled bearings according to bearing notes on fan assembly drawing and other instructions.

9. Start fan with driver and check for proper rotation direction.

10. Start equipment in accordance with recommendations of manufacturers of starting equipment and driver unit.

11. Allow unit to reach full speed, then shut down. During this short period check for vibration or any unusual noise. If any are observed, locate the cause and correct.

12. Lock the power source in "OFF" position.

13. Recheck for tightness of hold down bolts, all set screws and keys, and tighten if necessary. Initial start up has a tendency to relieve the tightness of nuts, bolts and set screws.

Assuming unit operates satisfactorily, the run-in period must be at least eight hours. Observe bearings a minimum of once each hour during the first eight hours of operation. **Overgreasing may cause bearings to heat up.** There need be no concern if the bare hand can be held on the bearing for one second on ambient air fans.

Sleeve bearing oil rings should rotate freely and carry oil. This can be checked by removing the inspection caps and using a flashlight to illuminate the rings. Check the equipment for vibration. If vibration is excessive, stop the fan and determine the cause of vibration. **Do not operate until cause has been corrected.** See Trouble Shooting Guide, Pages 14-15.

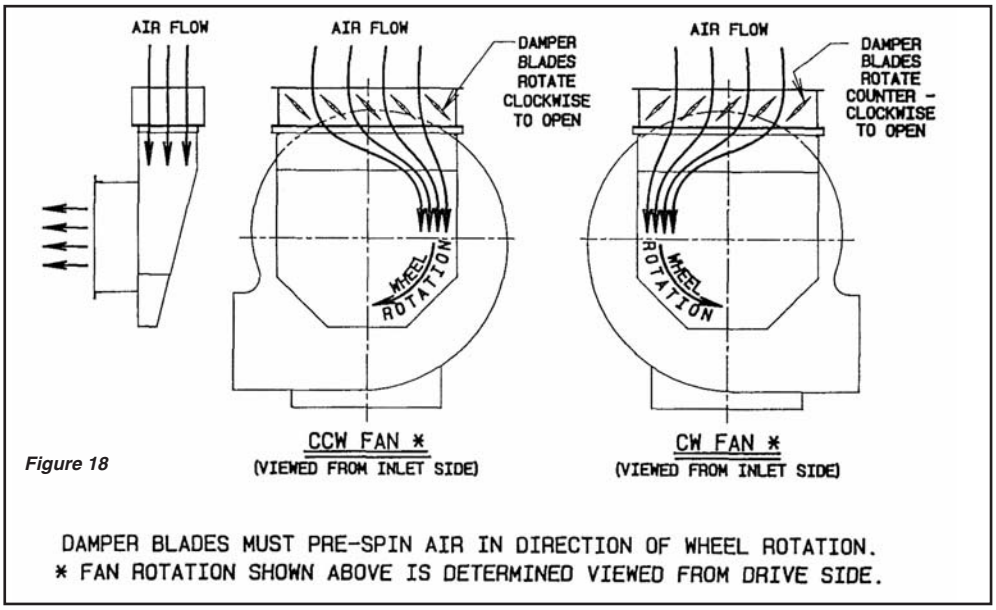

AIR FLOW
AIR FLOW
DAMPER BLADES ROTATE CLOCKWISE TO OPEN
AIR FLOW
DAMPER BLADES ROTATE COUNTER - CLOCKWISE TO OPEN
WHEEL ROTATION
WHEEL ROTATION
CCW FAN *
(VIEWED FROM INLET SIDE)
CW FAN *
(VIEWED FROM INLET SIDE)
DAMPER BLADES MUST PRE-SPIN AIR IN DIRECTION OF WHEEL ROTATION.
* FAN ROTATION SHOWN ABOVE IS DETERMINED VIEWED FROM DRIVE SIDE.

Figure 18

AERODYNAMIC PULSATIONS

Under certain conditions, a fan may experience damaging pulsations. This is not always obvious. It is characterized by a rumbling sound and vibration in the fan and ducts. There are two main causes, and the method of detection is different for each. Detection is important, for such pulsations can cause bearing failures or weld failures in the fan or ductwork.

First, the system resistance may be too high. The fan could go into stall if restricted beyond the design range of operation. This can happen if the actual resistance exceeds that which was specified. This condition may be detected by reducing the system resistance in a controlled manner and listening for a transition to smooth flow.

Second, the air control may be the cause. This would be either a prespin inlet damper or an inlet vane control. At moderate openings, say 20 to 60 percent open, a significantly higher rumbling sound can occur. This can be detected by listening and feeling as the air controller is closed from the wide open position. If the rumbling is present and long term operation is desired at this capacity setting, it is recommended that the inlet air controller be opened to the point where smooth air is obtained, then use an outlet damper to return to the desired capacity. This combination of control will greatly reduce the amplitude of the pulsations.

Warning

⚠ **Do not operate this fan in the stall/surge region. Refer to fan curve to assure operation is well to the right of the peak pressure curve. Operation of this equipment in the stall/surge region is extremely dangerous and may result in damage to the equipment as well as nearby personnel or other equipment. Operate this fan only in accordance with the Installation, Operation and Maintenance Manual.**

DOWELING OF BEARINGS

Bearings must not be doweled before the equipment has run 30 days. This allows for the foundation to settle or shift. Alignment of all components must be carefully checked, and location of bearings fixed. Holes are drilled through the base of the bearings and pedestals, then reamed to size to fit suitable dowel pins. Dowel pins are then driven into place. Threaded pins may be used if so desired.

Warning

⚠ **Never allow the fan rotating assembly to sit idle in temperatures above 200°F as this can "bake" the bearings, and cause premature bearing failure.**

Fan Balance

Heavy rotors and high speeds make dynamic balancing a necessity. This balancing is carefully done at our plant by experienced personnel. Occasionally, mishaps in transportation, handling, operation, or wear, will necessitate rebalancing in the field. The impeller must be rebalanced when mounted on a soft foundation and coupled to its own driver to suit the foundation peculiarities. ⚠ **However, fan motors can not be balanced or operated on weak or inadequately supported foundations.**

Balancing impellers is a delicate operation and requires specialized knowledge, experience, and careful procedures. ⚠ **A balance weight of a few ounces incorrectly placed may cause serious damage.** For these reasons we strongly recommend that an experienced Chicago Blower factory representative be contacted.

Bearing Vibration Limits

⚠ **Running fan(s) with high vibration could result in personal injury or property damage.**

Vibration amplitudes shown are peak velocity, inches/sec. and are measured in all three planes on bearing housings; vertical, horizontal and axial. See Table III.

⚠ **ALARM values are a warning that vibration must be corrected at the earliest possible moment (short term hours). Long term operation, at or exceeding ALARM values, greatly reduces rotor and bearing life/hours and voids the Chicago Blower warranty.**

⚠ **SHUT-DOWN limit signals hazardous operation and requires immediate repair. Operation at this limit voids the Chicago Blower warranty and could result in injury or property damage.**

Causes of Vibration

Refer to Trouble-Shooting Guide on Pages 14-15.

Table III – BEARING VIBRATION SEVERITY CHART

		ISO 1940 Standard	ANSI/AMCA Standard 204-205 Vibration Limits (in/sec)			
Application	AMCA Fan Category	Balance Grade	Factory Tested	Field Startup	Field Alarm	Field Shutdown
Industrial Process, Power Generation	BV-3	G6.3	.15	.25	.40	.50
Petrochemical Process	BV-4	G2.5	.10	.16	.25	.40

NOTES
1. CBC Standard is BV-3 and a Balance Grade of G6.3.
2. Balance Grade of G2.5 is available at additional cost.
3. Vibration Limits are for a fully assembled fan, rigidly mounted.
4. Values are peak velocity (filter out) at fan rotational speed.
5. Field vibration level of a fan is not solely dependent upon the balance grade. Installation factors and the mass and stiffness of the supporting system will influence the field vibration level. Therefore, field vibration is not the responsibility of the fan manufacturer.

To insure long life and trouble-free service, a frequent and regular check of all lubricants in bearings and couplings should be made. Sleeve bearings should be drained, flushed and refilled with clean oil after the first month, and every six months thereafter. Other types of bearings should be maintained in accordance with manufacturer's recommendations.

A preventative maintenance schedule is a necessity for an extended fan life. Establish a lubrication schedule based on time periods suggested in lubrication instructions and by motor manufacturers.

After approximately one (1) month of operation, all bolts for base, hub. bearing, pedestal, etc. should be retightened.

Potentially damaging conditions are often signalled in advance by changes in vibration and sound. A simple, regular audio-visual inspection of fan operation leads to correction of the condition before expensive damage occurs. Vibration levels should be checked by an approved technician using electronic vibration equipment.

Where air handled by the fan contains corrosive, erosive or sticky materials, fan should be shut down regularly for inspection, cleaning and reconditioning of interior parts, as well as a check of balance and vibration.

Mechanical Integrity

Certain operating conditions reduce the built-in strength of the fan impeller and may cause unsafe operation. It is the user's responsibility to inspect for these conditions as frequently as necessary and to make corrections as required. Failure to comply with the following limits voids the Chicago Blower Corporation warranty.

Temperature Changes

⚠ Temperature change rate exceeding 5°F per minute and temperature fluctuations exceeding 100°F **must not be applied to fan inlet air.**

Note: Fans with interference fit between the fan shaft and cast steel wheel hub may have a temperature rate change up to 30°F per minute. Consult your fan assembly drawing to verify the type of shaft/hub fit and hub material.

Maximum Safe Speed and Temperature

Operation exceeding maximum safe R.P.M. and temperature even for a short time causes overstressing or fatigue cracking of the impeller, resulting in unsafe conditions. Maximum safe speed and maximum safe temperature are shown on fan assembly drawings, catalogs or order acknowledgements.

REPLACEMENT PARTS

Renewal, repair or replacement parts are not stocked by Chicago Blower. If your fan is important to plant operation please order spare parts. Contact your local Chicago Blower sales office. When ordering parts the following information is necessary.

From Nameplate on Fan	Fan Type, Size, Serial Number
	or
From Original Purchaser	Fan Type, Size, P.O. Number and Customer Drawing Fan Number
Replacing Motor*	Frame Number, Make, HP, RPM and Electrical Characteristics
Replacing Coupling	Make, Bore for Drive Hub, Bore for Driven Hub and Size Must Refer to Fan Drawing for Shrink Fit
Replacing V-Drives	Order from Nearest Drive Supplier. Provide Numbers from Sheaves and Belts

*Repairs for motors should be ordered from the nearest authorized motor service station for the make of motor furnished. Check the manufacturer's website or yellow pages of your telephone directory.

TROUBLE-SHOOTING GUIDE

PROBLEM	CAUSE	REMEDY
VIBRATION	The most common cause of vibration problems is an out of balance fan wheel or rotor.	Check the wheel for dirt or foreign material, especially hard-to-see places like the backside of the wheel and the underside of the blades. Airfoil blades are usually hollow. When exposed to rain or excessive moisture, they can get water inside of them. Drilling one 3/16" drain hole in the upper surface of each blade near the trailing edge should cure the problem. Rebalancing is usually not necessary.
		Inspect the wheel for erosion or corrosion. Usually wheel erosion will occur at the leading edge of the blade. On a paddle wheel type fan the outer blade tip may also be worn. An airfoil wheel exposed to sand or abrasive dust can actually develop pin holes in the leading edge of the blade.Do all you can to eliminate these damaging conditions and then rebalance the wheel. If the wheel is seriously damaged it will have to be replaced.
	Improper or loose mounting.	Foundation bolts and bearing mounting bolts can loosen themselves. Make sure they are tight.
	Loose set screws that hold the wheel to the shaft.	Again tighten the screws, but first be certain the wheel hasn't shifted on the shaft or is rubbing on the inlet cone or drive side of the housing.
	Bent fan shaft.	First, check the shaft with a dial indicator. If bent, it should be replaced as soon as possible to avoid replacing the entire fan.
	Misaligned V-belt drive.	Realign assembly so fan and motor shaft are parallel and faces of sheaves (pulleys) are flush to a straight edge. A taut string will work fine. Refer to page 9.
	Fan wheel turbulance due to the rotor running backwards.	Since blade angles and shapes vary greatly, it is easy to misread rotor direction. Check for correct wheel rotation, clockwise or counterclockwise, as seen from the drive side. Refer to page 5.
	Air pulsation.	Fan may be operating in the stall area of its performance curve. That means it is oversized for your particular system or the system resistance is higher than intended. You can lower the system resistance by cleaning the filters or opening the dampers.
NOISE	Foreign material in the fan housing.	This could be anything from a loosened bolt to somebody's lunch bag. Inspect the wheel and inside of fan housing and clean thoroughly.
	Squealing V-belts.	The belts are either loose or misaligned. If belts show wear, replace them now to avoid a future breakdown.
	Worn ball or roller bearings (howling, screeching or clicking).	Change the bearings immediately before they cause additional damage. Failing bearings tend to wear the shaft, so you want to be absolutely certain the shaft is full size before installing new bearings. "Mike" the shaft under the bearing and next to it and compare the two readings. If they don't match, replace the shaft. New bearings installed on a worn shaft will not last long.
	Bearing seal misaligned (high pitch squeal)	Realign the face of the bearing so that it is perpendicular to the shaft.
	If the fan housing has a metal shaft seal, it could be misaligned and rubbing on the shaft.	Loosen seal plate bolts, recenter the seal on the fan shaft and tighten the bolts. If the seal is fiberglass, cork or rubber, be sure the metal backing plate does not touch the shaft.

TROUBLE-SHOOTING GUIDE

PROBLEM	CAUSE	REMEDY
OVERHEATED BEARINGS (See Note Below)	Bearings may be worn and failing	Replace the bearings. Remember to also check the shaft (refer back to the NOISE section on the previous page)
	Improper grease.	Use a lithium base, high speed, channeling type grease. Do not use a general purpose grease.
	Overgreasing.	If you allow the bearing to run for a few hours, it will normally purge itself of extra grease. You can simply remove excess grease from split roller bearings by lifting the top half of the block for access.
	Bearing exposed to "heat soak" from an oven or dryer after shutdown.	"Heat soak" occurs when a fan is idle and its shaft cooling wheel can no longer prevent heat from reaching the inboard bearing. Heat from inside the fan can then actually cook the grease. Continue to run the fan for 15 minutes after the oven heat is turned off. This will cool the fan shaft and protect the bearing.
	Loose V-belts may cause belt slippage and friction heating, resulting in hot bearings, shafts, or sheaves.	Tighten belt to the proper tension. A good rule of thumb is you should be able to depress the belt the same distance as the thickness of the belt. Tension should be just tight enough to prevent squealing.
	Excessive V-belt tension.	Belts may be too tight. Adjust to the correct tension.
POOR AIR PERFORMANCE	Fan rotation incorrect.	Refer to the Vibration section on the previous page. An easy way to change rotation on most 3-phase motors is to reverse any two motor leads.
	Abrupt turn in the duct close to the fan discharge or air pre-spin caused by ductwork elbows in the inlet.	Install turning vanes or elbow splitters in the duct. If air performance is still inadequate, the discharge position may have to be changed. Refer to page 3.
	If fan has an Inlet Volume Control (IVC), is it improperly installed?	Be sure the IVC is installed with pre-spin of the air in direction of wheel rotation when the IVC is partially closed. Refer to page 5.
	Off-center wheel.	This can occur on double-width, double-inlet fans. Center the fan wheel between the inlet cones to avoid overloading one side of the wheel while starving the other.
	Fan horsepower unexpectantly low.	Correct one or more of the following conditions. • Air pre-spin into the fan inlet. • Fan drive sheaves set too low for fan speed. • Resistance to airflow, such as a closed damper, much higher than calculated.
	Fan horsepower unexpectantly high.	Be sure the fan speed is not too high. Fan may be operating without ductwork at low resistance so that too much air is flowing. The fan may be handling ambient air when it was originally intended for hot, less dense air. Fan my be running backwards.

NOTE: Ball or roller bearings tend to heat up when they have been overgreased and will cool down to their normal running level when the excess grease oozes out. The normal operating temperature of a bearing may be well above the 140°F which is "hot" to touch. Temperatures over this have to be read with instruments and anything over 180° should be questioned. If you put a drop of water on the bearing and it sizzles, the bearing is in distress and should be changed before it seizes and ruins the fan shaft.

Figure 19A

Plain PLXC
Pillow Block

Figure 19B

Water-Cooled
PLXC Pillow Block

Dodge Sleevoil Pillow Block Bearings – (Sizes 3-15/16" thru 8" PLXC)

INSTALLATION

The design of this pillow block allows the use of the PLXC liner. This is accomplished by using a universal grommet for the application.

Complete basic pillow block assemblies are shipped in two packages; the housing and associated parts are in one package and the liner in the other. Any optional accessories are packaged separately.

Before mounting the pillow block read all instructions in this manual to become familiar with the mounting procedure and pillow block parts nomenclature.

1. Check mounting structure making sure it is rigid, level and well supported. Inspect shaft to insure it is smooth (32 micro-inch finish or better), within commercial tolerances and free of burrs or rough spots.

2. Disassemble and thoroughly clean all parts of the pillow block. Housing caps and liner caps are matched to their bases and **should not be interchanged.** Housing and liners should be interchanged as assemblies only.

3. Position housing base on pedestal so that oil gage is in the position specified on the construction drawing. **Do not tighten housing base to pedestal.** Apply oil to the spherical seats in the housing base.

4. Note location of thermocouple holes in liner base. Set liner base in housing base so thermocouple holes in housing align with holes in liner. Thermocouple holes in housing base are on side opposite oil gage holes (oil gage side of housing base is marked "X"). Apply oil to liner bearing surface.

5. Apply oil to shaft in the bearing area and set shaft in place.

6. Check alignment of pillow block by noting clearance between housing and shaft at each end of the housing. Clearance should be uniform within 1/32". Use shims under base as required. Alignment of pillow block should be as accurate as possible. The self-alignment feature of the unit is to compensate for normal shaft deflection and possible settling of the supports.

7. Place oil rings around outside of lower liner and over shaft. Peen screws to insure that they are secure. Make sure rings rotate freely on shaft.

8. For Fixed Bearing: Remove clamp screws from thrust collars and make sure cracked joint is clean. Place one collar half on shaft so that finger groove is next to the liner base. Rotate collar half around shaft and place other half in position. Bring halves together at joint, making sure match at joint is perfect and insert clamp screws. There should be no offset at collar face. Tap halves together and tighten clamp screws. Repeat above operation for opposite end of bearing. **Assemble two collars on one bearing only.**

Tap collar up to face of lower liner allowing a total of .008" to .016" running clearance and tighten set screws. Collar should run parallel to end face of liner within 002". See Axial Clearance Table V, Page 19.

9. Apply oil to bearing surface of liner cap. Locate cap in place on lower liner, making sure oil rings are in their cavities and are free to rotate. Install and tighten cap screws.

10. Tighten housing base to pedestal.

11. Thread dust seal and seal retainer into groove at the end of housing base and around shaft. Slide free end of seal retainer thru clasp and pull tightly. Hold clasp with long nose pliers and pull free end of retainer as tightly as possible with another pair of pliers. Cut off excess material and press down clasp lip. Seal retainer may be disengaged by inserting a straightened paper clip between the bands at the clasp and pulling the free end of the retainer out of the clasp.

12. Apply 515 Gasket Eliminator to SLEEVOIL housing base along outer contour of joint. **Note:** Special care should be taken at grommet area. **Loosen plunger screw** and locate housing cap on base taking care not to damage dust seals or gasket material. Tighten housing bolts then turn plunger screw down snugly. **The plunger screw must be loose until the housing bolts have been tightened.**

Cap Loaded Bearings: If shaft must be held down to install cap, tighten plunger screws tightly with shaft held down. Mark position of plunger screw. Loosen plunger screw one complete turn and loosen shaft hold-down. Then tighten plunger screw while tightening shaft hold-down until plunger screw is tightened to the mark. Do not over-tighten shaft hold-down as this can misalign the bearing. Remove shaft hold-down and tighten plunger screw locknut. Torque per Table IV, Page 19.

Note: Do not tighten plunger screw on accompanying base loaded bearing until cap-loaded bearing has been installed and hold-down removed.

Base Loaded Bearings: Tighten plunger screw locknut. Torque per Table IV, Page 19.

13. Plain Liner: When using a Plain Liner (without coolant pipes), install grommet and grommet plate over openings in the sides of the housing. To reduce chance of oil leakage, a non-hardening sealant may be used.

Externally Cooled Liner: When PLXC Liners (with coolant pipes) are to be used, install grommet and grommet plate over pipes and tighten screws.To reduce chance of oil leakage, a non-hardening sealant may be used on pipes and housing faces.

14. The oil level gage may be located any distance from the pillow block by the use of a coupling and pipe of the desired length.The extended pipe must be supported so that it remains straight and perfectly level. Use a spirit level. Do not guess. Use pipe sealer on all connections.

15. Remove all pipe plugs and reinstall using pipe sealer. Tighten securely.

16. Make pipe connections required for coolant, making sure that all pipe lengths are correct and unions are well aligned. **Careless fitting will result In serious preloading of bearing**. Lengths of flexible hose between pillow block and rigid piping are recommended to avoid preloading of bearing. A regulating valve should be placed ahead of the inlet and a slight drain at the outlet for liquid coolants. The recommended method of pipe connection for liquid coolants is to connect the inlet to one pipe and the outlet to the other pipe on the same side of the bearing. A return is then used to connect the two pipes on the other side of the bearings (See Figure 20). Adjust coolant flow rate specified on construction drawing or to suit conditions. See Table VI on Page 19. When using air as the cooling medium, connect an inlet to each pipe on one side of the bearing and an outlet to the pipes on the other side.

Warning: Water cooled sleeve bearings must be protected from freezing. If they are to remain idle in freezing temperatures, the liner water chambers must be blown clear with compressed air.

LUBRICATION and OPERATION

Since the satisfactory operation of the pillow block depends almost entirely on the oil film being maintained between the shaft and liner bearing surface, **it is recommended that a high grade straight mineral oil with rust and oxidation (R & 0) inhibitors and antifoam agents be used.** Information regarding qualities and properties of specific oils should be referred to the lubricant manufacturers. See Table VII and VIII, Page 19 for further information.

Fill the pillow block with oil to the top of the center circle in the oil gage. After placing into operation, remove inspection covers and check to make sure oil rings are bringing up oil. Operation should be checked frequently during the first few days. If noise develops, check alignment of housing, collar runout, plunger screw and all operating parts. Check all points and make sure all screws and nuts are tightened after several days operation. Drain, flush and refill with oil after 2 to 3 weeks of operation and every 3 months thereafter for continuous service and every 6 months for 8 hours a day service. Visually check the oil for contamination periodically between oil changes. **Maintain oil level above bottom of center circle at all times while unit is in operation.**

For water cooled bearings, check fan general assembly drawing. Use flow rate shown in Table VI as a general starting point for proper cooling. Lower coolant inlet temperature and (or) lower ambient temperature require less flow. If the coolant inlet temperature exceeds 90F, additional coolant will be required. Antifreeze type additives may be used with the water in cold operating environments, otherwise purge all coolant from the liner by blowing out with compressed air or steam anytime bearing coolant is subject to freezing.

Any questions on installation, maintenance or operation should be referred to the equipment manufacturer.

CAUTION: High air pressure may damage equipment. The fluid or air pressure should never exceed 120 p.s.i.

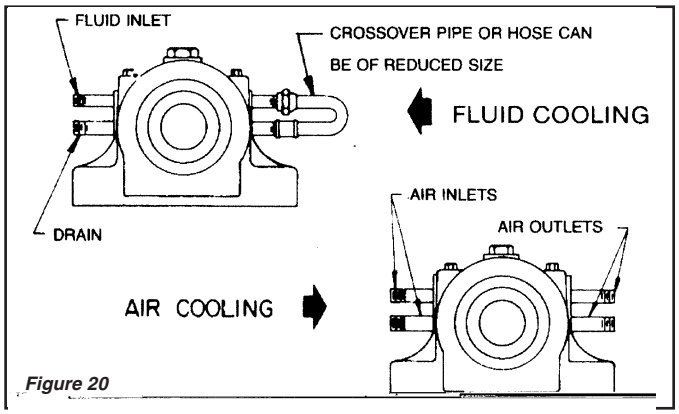


Figure 20

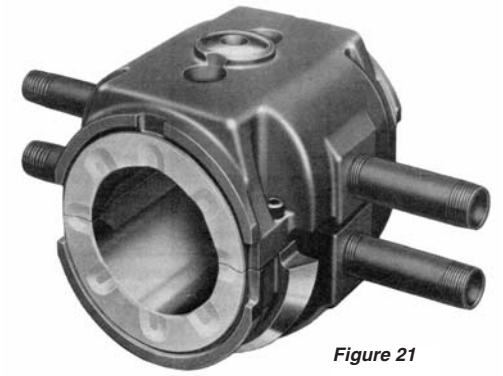


Figure 21

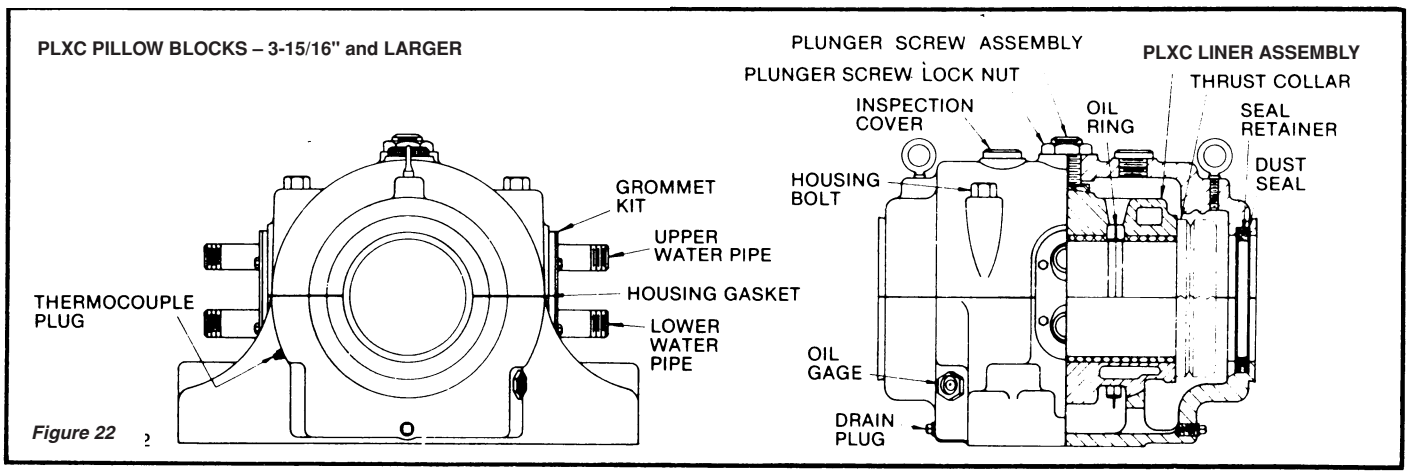


Figure 22

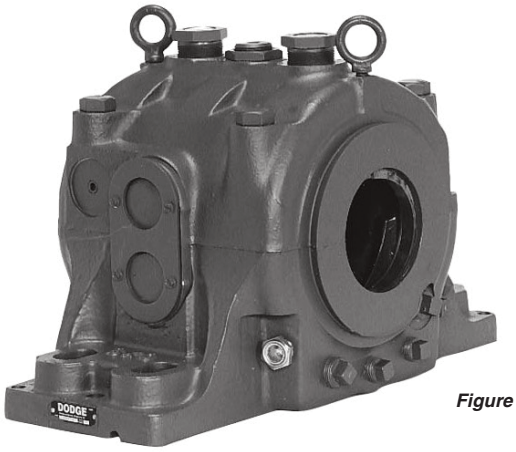


Figure 23

SLEEVOIL RTL Pillow Blocks are designed for applications requiring a bearing with high thrust load capacities. RTL water or air cooled pillow blocks are available in expansion or non-expansion types and can be modified for circulating oil.

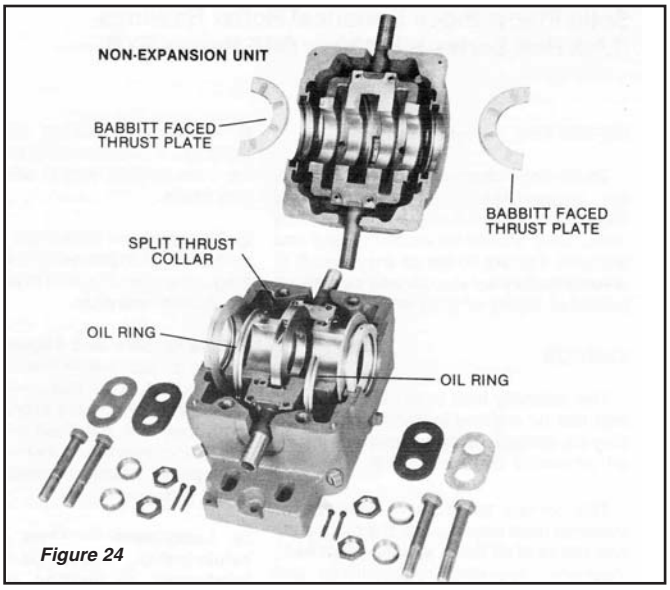


Figure 24

Dodge Sleevoil RTL Pillow Block Bearings – (Sizes 3-7/16" thru 10")

INSTALLATION

The installation of this bearing is essentially the same as the PLXC bearing on Page 16. The difference is that the RTL bearing has a single thrust collar in the center with thrust plates on each side. Proceed with installation per Sections 1-3 Page 16, then:

4. Set liner base in housing base. When using circulating oil or a thermocouple make sure the holes in the liner will align with the holes in the housing when the pillow block is assembled. Apply oil to the liner-bearing surface.

5. Inspect shaft to insure it is smooth (32 micro-inch or better), within commercial tolerances and free of burrs or rough spots.

⚠ If bearing used is a non-expansion (fixed) type, check thrust collar for burrs and scratches. Use crocus cloth **(not emery)** to smooth any scratches on thrust collar faces. If clamp-on type thrust collar is used, it should now be installed. Remove jam screws and back off set screws so they do not protrude into the I.D. of the thrust collar. Remove clamp screws and make sure joints of thrust collar are clean. Place both halves of thrust collar into shaft groove and tighten clamp screws alternately and evenly. See Table IV, Page 19. The collar faces should be smooth with no offsets at the split. Tighten the set-screws, see Table IV, Page 19. Install and tighten the jam screws. Oil shaft in the bearing area and set shaft in place. The thrust collar must be centered in the cavity of the liner base.

6. Place oil ring around outside of liner base and over shaft. Install and peen oil ring screws to insure they are secure. Make ⚠ sure rings rotate freely on shaft. **Note: Do not use oil rings if liner cap has baffles installed In the oil ring grooves.**

⚠ 7. **For Non-Expansion Bearings:** Clean one set of the babbitt faced thrust plates. **Note that the plates are matched halves and must not be interchanged.** Carefully smooth any scratches ⚠ on babbitted face with crocus cloth **(not emery cloth or sandpaper)**. Oil plate halves generously. First install the plate half without milled slots in the steel back. Press the babbitted face against the thrust collar and rotate plate around shaft into liner cavity. Install retainer washer in groove in liner base. Rotate plate until stopped by retainer washer. Place other thrust plate half (half with two milled slots in steel back) against thrust collar, making sure babbitt faces the thrust collar. Clean and oil the second thrust plate set and install in the same manner. It may be necessary to move the shaft slightly to obtain enough clearance in the liner cavity to install the lower thrust plate half. (Caution: the bearing is not yet fastened in place and can be moved).

Note: Thrust collar clearances for all size RTL Bearings are .015 - .030. ⚠

8. Apply oil to the bearing area of the liner cap. Locate liner cap on liner base (cap is not reversible on base). Make sure oil rings rotate freely. End faces of liner should have no appreciable offset. Install and tighten cap screws alternately. If liner cap on the non-expansion bearing will not drop into place, remove it and reposition thrust plates tightly against thrust collar. Then reinstall liner cap.

Caution: If it ever becomes necessary to remove liner cap, make certain that both upper thrust plate halves remain In place next to the thrust collar. If a plate half should remain In the liner cap It can drop from the liner and cause injury. ⚠

9. Check alignment of pillow block by noting clearance between housing bore and shaft at each end of the housing. Clearance should be uniform within 1/32". Use shims under base as required. Alignment of the pillow block should be as accurate as possible. The self-alignment feature of the unit is to compensate for normal shaft deflection and possible settling of the supports.

10. Tighten mounting bolts securely. Shaft should rotate freely.

11. Wrap the O-ring (rubber cord) around the shaft in the seal area and cut it to fit the shaft. Disassemble one seal and place one half on shaft with finger facing liner. Locate O-ring in seal groove and rotate seal half around shaft into housing base groove. For most effective sealing, ends of O-ring must meet. Cementing ends together is recommended. Install other half of seal and tighten screws. Install second seal in same manner.

Continue with Sections 12-16 on Pages 16 and 17 of the PLXC instructions. See Table IV, Page 19 for Plunger Screw Torque information.

Table IV

PLXC and RTL SLEEVOIL SCREW and TORQUE VALUES

Sleeveoil Size	Thrust Collar				Plunger Screw	
	Clamp Screw		Set Screw			
	Screw Size (Soc. Hex)	Wrench Torque (In-Lbs)	Screw Size (Soc. Hex)	Wrench Torque (In-Lbs)	Wrench Size (Soc. Hex)	Wrench Torque (In-Lbs)
1-15/16	1/4-20NC	160	5/16-18NC	140	5/8	300
2-3/16	5/16-18NC	325	7/16-14NC	350	5/8	350
2-7/16	5/16-18NC	325	7/16-14NC	350	5/8	400
2-11/16	3/8-16NC	580	1/2-13NC	600	5/8	450
2-15/16	3/8-16NC	580	1/2-13NC	600	5/8	450
3-7/16	1/2-13NC	1425	5/8-11NC	1200	5/8	500
3-15/16	1/2-13NC	1425	3/4-10NC	1750	3/8	850
4-7/16	1/2-13NC	1425	3/4-10NC	1750	1/2	1250
4-15/16	1/2-13NC	1425	3/4-10NC	1750	1/2	1250
5-7/16	1/2-13NC	1425	3/4-10NC	1750	1/2	1250
6	5/8-11NC	2800	7/8-9NC	3500	5/8	2500
7	5/8-11NC	2800	7/8-9NC	4100	5/8	2500
8	3/4-10NC	5000	1-8NC	5000	5/8	2500
3-7/16 RTL	1/4-20NC	160	5/16-24NF	160	3/8	850
3-15/16 RTL	1/4-20NC	160	5/16-24NF	160	3/8	850
4-7/16 RTL	1/4-20NC	160	5/16-24NF	160	1/2	1260
4-15/16 RTL	5/16-18NC	325	5/16-24NF	160	5/8	2500
5-7/16 RTL	3/8-16NC	580	3/8-16NC	275	5/8	2500
6 RTL	1/2-13NC	1425	3/8-16NC	275	5/8	2500
7 RTL	1/2-13NC	1425	3/8-16NC	275	5/8	2500
8 RTL	1/2-13NC	1425	5/8-11NC	1200	3/4	3600
9 RTL	5/8-11NC	2800	5/8-11NC	1200	3/4	3600
10 RTL	3/4-10NC	5000	5/8-11NC	1200	3/4	4800

Table V

PLXC SLEEVE BEARINGS - AXIAL CLEARANCES BETWEEN LINER AND COLLARS

Bearing Size (inches)	TOTAL CLEARANCE (inches)	
	Minimum	Maximum
1-7/16	.005	.009
1-11/16	.006	.012
1-15/16	.006	.012
2-3/16	.008	.014
2-7/16	.008	.014
2-11/16	.008	.014
2-15/16	.008	.014
3-7/16	.008	.014
3-15/16	.008	.014
4-7/16	.008	.014
4-15/16	.010	.016
5-7/16	.010	.016
6	.010	.016
7	.010	.016
8	.010	.016

Note: Thrust collar clearance for all size RTL bearings is .015-.030 inches.

Table VII

REQUIRED OIL VISCOSITY*

Room Temp. During Start-Up	Speed	SAE Oil Required
Below –10°	All	Consult Equipment Manufacturer
–10°F to 32°F	All	SAE 10
32°F to 70°F	Low High	SAE 20 SAE 10
Above 70°F	Low High High	SAE 30 SAE 10 – Light Loads SAE 20 – Heavy Loads

*** If not specified by equipment manufacturer.**

Oil film temperature in liner during operation should not exceed 180°F. If in doubt, consult equipment manufacturer. Use high grade, high quality, well refined petroleum oils of the straight mineral type, with rust and oxidation inhibiter and anti-foam agent only.

Approximate Viscosity:
SAE 10 – 183 SUS at 100°F; 46 SUS at 210°F
SAE 20 – 348 SUS at 100°F; 57 SUS at 210°F
SAE 30 – 489 SUS at 100°F; 65 SUS at 210°F

Table VIII

RECOMMENDED TURBINE GRADE OILS - ASTM D-943 (1800 Hrs.)

Bearing Temperature	SAE Viscosity	Texaco Designation (or equivalent)
100° - 160°F	20	Regal R&O- 68
160° - 170°F	30	Regal R&O-100
170° - 180°F	40	Regal R&O-150

RECOMMENDED SYNTHETIC OILS

Bearing Temp.	Mobil 632	Mobil 634
210°F	115 SSU	148 SSU
100°F	1535-1704 SSU	2215-2460 SSU

Table VI

PLXC BEARING SPECIFICATIONS

Pillow Block Size	(1) Max. RPM for Ring Oiling	(2) Water Flow (GPM)	(3) Air Flow (CFM)	(4) Pressure Drop Reqd. Air Cooling (PSI)	(5) Oil Flow Rate for Circ. Oil (PSI)	(6) Oil Volume		
						Fluid Oz.	Qts. Approx.	Liters Approx.
3-15/16	2910	1.75	52	.19	3.0	50	1-1/2	1.45
4-7/16	2582	2.25	63	.22	3.5	64	2	1.90
4-15/16	2321	2,50	77	.11	3.5	90	2-3/4	2.70
5-7/16	2107	3.00	90	.12	5.0	100	3-1/8	2.95
6	1910	4.00	104	.18	5.5	132	4-1/8	3.90
7	1637	5.00	156	.40	6.5	240	7-1/2	7.10
8	1432	6.50	173	.50	7.5	320	10	9.5

(1) Converted from 3000 FPM Speeds above 3000 require Circulating Oil.
(2) Based on 90°F ambient temperature and 90° water inlet temperature. Cooler ambient and/or water inlet temperatures require less flow. Pressure drop across bearing approximately 1 P.S.I.
(3) Based on 90°F ambient and 90° air inlet temperatures. Cooler ambient and/or air inlet temperatures require less flow.
(4) Minimum back pressure required for proper air circulation through the liner coolant chambers.
(5) Flow rate required at 120°F oil inlet temperature, 90°F ambient air temperature and at 6000 FPM shaft speed under maximum radial load. Slower speeds and lighter loads require less flow.
(6) Volume of oil required to fill pillow block to top of center circle in oil gauge. Applies to both XC and Plain Pillow Blocks. 32 fluid oz. = 1 qt. = .94636 liters.

Solid Pillow Block Spherical Roller Bearings
Link Belt Series B22400 and B22500 or SKF Series SYR

IMPORTANT – Read Carefully

These instructions are provided to aid in the proper installation, operation and maintenance of spherical roller bearing units. They should be carefully read and followed. **Failure to do so may result in unsatisfactory service as well as serious personal Injury or property damage.**

CAUTION

The reliability built in all Link-Belt bearings can be realized in service only when they are correctly selected, properly installed, protected and maintained.

The correct selection of bearings or mounted units requires that the magnitude and nature of all loads, speeds, alignment, mounting, operating requirements and maintenance be adequately considered. The selection of materials for and design of housings, shafting, fasteners, seals, accessories, as well as provisions for installation and maintenance, must follow good engineering principles.

Housings must be selected and installed with regard to the degree and direction of the forces that will occur. Housings should not be used under tension loads except with adequate safety factors. For this reason pillow blocks are best suited to withstand radial loads passing through the base. When heavy loads or shock loads are possible, it is important to mount a unit so that the line of force passes directly into its base, or so that the unit is directly and substantially supported other than through its mounting bolts. Where the line of force falls outside the base, such as with horizontal or uplift loads on pillow blocks, serious housing and fastener deflection or failure may occur. These conditions may require designs using different materials, fasteners, mounting design, stop bars, etc. together with proper safety factors.

The following general points of installation and operation are very important.

A. Cleanliness - Keep dirt, water and metal chips off all parts.

B. Careful Handling - Hammer blows or improper use of force can damage precision parts.

C. Shaft Fits - Bearings should have proper shaft fits to minimize fret wear. See installation instructions for shaft tolerances.

D. Bolts - Housing mounting bolt tightness is important to prevent the housing from shifting, and to adequately support loads.

E. Set Screws - Set screws must be properly torqued to prevent the shaft from slipping in the inner ring and to prevent loosening during operation.

F. Free Rotation and Alignment - Check for free rotation before machine start-up to assure that final alignment is proper. Although bearings are alignable in housings, they will not "self-align" in many cases and destructive moment loads may be imposed if initial installation alignment is not provided.

G. Lubrication - Units designed for relubrication must be adequately lubricated. A bearing not properly lubricated can run to destruction and possibly cause damage to other components. Add grease slowly. Rapid application may blow the seals and allow grease to escape.

INSTALLATION

1. Check Shaft - Shafting must be clean, round, straight, free of burrs and nicks and of correct size. For the average installation with moderate loads and speeds, the shaft should measure as follows.

SHAFT DIAMETER	RECOMMENDED TOLERANCE
1/2″ thru 2″	Nominal to minus .0005"
2-1/16" thru 4"	Nominal to minus .0010"
4-1/16" thru 5"	Nominal to minus .0015"

2. Shaft Preparation - When frequent removal of bearings is anticipated, file flats on the shaft approximately 1/16″ deep under the collar set screw locations. This provides for easy removal, as bearings will clear the burrs caused by correctly tightened set screws.

3. Lubricate Shaft & Bearing Bore - Coat the shaft and bearing bore with grease or oil to facilitate assembly.

4. Assemble on Shaft - If it is necessary to tap or press units on the shaft, use a hardwood block, soft steel bar or tube against the end of the inner ring. Do not strike or exert pressure on housing or seals.

5. Bolt Fixed or Locating Unit to Support - Bolt fixed unit securely to its support. Bolt grade selection is important on many applications depending on load and shock conditions. SAE Grade 5 mounting bolts properly torque can be used. Grades over SAE 5 should not be used with cast iron housings.

6. Final Positioning - Establish final shaft position and secure locking collar or fixed unit to shaft. Tighten collar set screws to the torque values given in Table IX.

Table IX
SET SCREW TIGHTENING TORQUE

Shaft Size (in.)	Seating Torque (in/lbs)*
3/4 to 1-1/4	125
1-5/16 to 2	225
2-1/16 to 2-1/4	325
2-5/16 to 3-1/2	475
3-9/16 to 5	1150

* Values can vary ± 5%

Note: Satisfactory tightness can be obtained using a standard hex wrench (50-52 minimum RHN C) and tightening until a slight permanent twist is obtained in wrench for each screw.

7. Bolt Expansion or Other Unit to Support - If an expansion unit is used, position the cartridge in the housing to allow for adequate movement in the direction of expected expansion. Align and shim the housing as necessary to place the bearing in the approximate centers of their housing alignment range. Bolt unit securely to its support (Reference step 5).

8. Final Mounting - Rotate shaft slowly, under load if possible, for several revolutions to properly center the roller elements with respect to the raceways. Securely tighten collar set screws of remaining bearing, following the same procedure as outlined under step 6.

9. Check System for Freedom of Rotation - Any condition of strain, irregular rotational torque, abnormal sound or vibration may be due to improper alignment, improper location, bent shaft, distorted supports, etc. Installation should be rechecked and corrections made as required.

The use of stop bars welded to the support at each end of the units leaving about 1/32" space for ease of assembly is good practice. Wedge shims in 1/32"-space after units are securely fastened. These bars assure proper location of the units and prevent shifting when loads are applied.

LUBRICATION

Units are prelubricated with lithium base NLGI #2 grade grease, but make sure they have adequate grease. As a precaution, if equipment is to be built and left idle for any period of time prior to actual use, the units should be filled 100% full to provide maximum protection from corrosion, etc. The suggested relubrication schedule under Table X is a general guide.

The specific conditions on an application such as exact hours of operation, temperature, moisture, speed and dirt govern the required lubrication cycle. This can be determined by inspection of the flushed out lubricant during a trial period of operation. Add grease slowly. Use a sufficient volume of grease to purge bearing seals of old lubricant. It is preferable to rotate bearings during relubrication where good safety practice permits.

Inspect bearing installations at least every six months. Any unusual noise or vibration change should be immediately investigated. ⚠

Table X – BEARING GREASE

AMBIENT CONDITIONS		OPERATING CONDITIONS		BEARING OPERATING TEMPERATURE (°F)		SUGGESTED GREASING INTERVAL**	USE THESE GREASES or EQUIVALENT
Dirt	Moisture	Load	Speed	Low	High		
Clean	Dry	Light to Medium	Slow to Medium	0	120	2 to 6 Months	High quality NLGI #1 or #2 multi-purpose bearing greases are generally satisfactory. Consultation with a reputable lubricant supplier is recommended.
				120	200	1 to 2 Months	
Moderate to Dirty	Dry	Light to Medium	Slow to Medium	0	120	1 to 4 Weeks	
				120	200	1 to 7 Days	
Extreme Dirt	Dry	Light to Medium	Slow to Medium	0	200	Daily - Flushing Out Dirt	
*	High Humidity - Direct Water Splash	Light to Heavy	Slow to Medium	32	200	1 to 4 Weeks - Grease at Shutdown	Mobil Oil Corporation, Mobilith AW-2 Texaco Inc., Premium RB2 Shell Oil Company, Alvania EP2
		Heavy to Very Heavy	Slow	0	200	1 to 8 Weeks	Shell Oil Company, Alvania EP2
				– 20	120	1 to 8 Weeks	Mobil Oil Corporation, Mobiltemp 78
		Light	High Speed	100	200	1 to 8 Weeks	Amoco, Rykon No. 2 Texaco Inc., Premium RB 2
	Possible Frost	Light to Heavy	Slow to Medium	– 65	250	1 to 4 Weeks - Grease at Shutdown	Mobil Oil Corporation, Mobiltemp SHC32 Texaco Inc., 2346EP Low Temp Shell Oil Company, Aeroshell 7A
Clean to Moderate	Dry	Light to Medium	Slow to Medium	80	250	1 to 8 Weeks	Union Oil Company, Unoba EP2 Mobil Oil Corporation Mobiltemp 78
Clean to Dirty	Dry	Light	Slow	80	300	1 to 4 Weeks	Keystone Lubricants Company, No. 89 Dow Chemical Company, DC44

* Additional bearing protection or special sealing may be required.
** Suggested starting interval for maintenance program. Check grease condition for oiliness and dirt and adjust greasing frequency accordingly. Watch operating temperatures. Sudden rises may show need for grease or indicate over lubrication on higher speed applications.

Chicago Blower Corporation cannot be held responsible for performance of individual batches of grease. Changes in lubricant specifications, performance, and lubricant guarantees are the responsibility of the lubricant manufacturer.

Spherical Roller Adapter Bearing - Center Hung Wheels (refer to Pages 22 and 23)

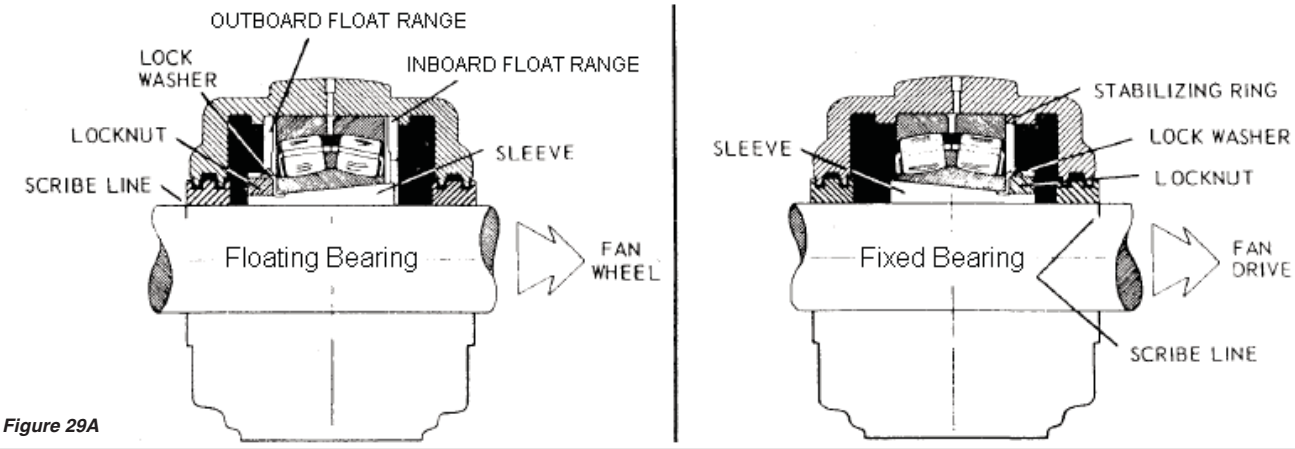


Figure 29A

Split Pillow Block Spherical Roller Bearings
Link Belt Series 6800 or SKF Series SAF 22500

IMPORTANT – Read Carefully

These instructions are provided to aid in the proper installation, operation and maintenance of spherical roller bearing units. They should be carefully read and followed. **Failure to do so may result in unsatisfactory service as well as serious personal Injury or property damage.**

The following general points of installation and operation are very important.

A. Cleanliness - Keep dirt, water and metal chips off all parts.

B. Careful Handling - Hammer blows, overheating or improper use of force can damage precision parts.

C. Adapter Sleeve Tightening - Bearings must be correctly forced up their tapered adapter sleeves to obtain the recommended clearance removal. Improperly tightened bearing and adapter assemblies may slip or turn on the shaft. See table XI.

D. Bolts - Housing mounting bolt and cap tightness is important to prevent the housing from shifting, and to adequately support loads.

E. Free Rotation and Alignment - Check for free rotation before machine start-up to assure that final alignment is proper.

F. Lubrication - Units must be adequately lubricated. A bearing not properly lubricated can run to destruction and possibly cause damage to other components. See Table X, Page 21.

INSTALLATION

1. Preparation - Remove parts from carton but do not remove parts from individual wrapping until ready to use. The preservative on the bearing is compatible with most petroleum lubricants and normally need not be removed. Cap and base are machined as matched units and are not interchangeable. Mark each before taking apart to prevent mixing with other bases or caps. Review fan assembly drawing to verify location of fixed and floating bearings.

2. Mount Housing Base - Use jack-screws in dowel pin holes to disassemble base and cap. Avoid use of pry or wedge at the split line. If oil cup or feed line is used, install at this time using sealant on all plumbing threads. Be sure housing support plate is flat and free from warpage. Bolt base to support square with the shaft. Draw up base mounting bolts snugly, but not to final tightness.

3. Check Shaft - Shafting must be clean, round, straight, free of burrs and nicks, and correct size. Shafts should measure as follows:

SHAFT DIAMETER	RECOMMENDED TOLERANCE
7/16" to 2"	Nominal to minus .003"
2-1/16" to 4"	Nominal to minus .004"
4-1/16" to 6"	Nominal to minus .005"
6-1/16 to 13"	Nominal to minus .006"

If felt "A" seals are used, be sure that any tool marks or ridges are removed under the seal area. For higher speed operation with felt seals, shaft should be polished or ground to 10-20 micro-inch finish.

4. Assembly on Shaft - Slide steel seal rings, if used, bearing, adapter and accessory parts on the shaft in the right order. See Figure 25. Also see Figure 29A, Page 21 for A/3 and A/7 (for center hung wheels), Figure 29B, Page 23 for A/1, A/8 and A/9 (for overhung wheels). Apply mixture of white lead and oil or a powdered dry lubricant to tapered surface and threads of adapter sleeve and to the inside (small) face of the locknut.

5. Position on Shaft - Locate the bearing and sleeve snugly on the shaft in the desired position. Fixed bearings are located with the bearing face opposite the locknut up against the housing shoulder. Expansion bearings are usually centered in the housing seat between the shoulders to allow for shaft expansion or contraction. A shaft with a pair of bearings normally has one fixed and one expansion pillow block. The fixed unit is usually located adjacent to the drive. The fixed bearing takes any thrust loads. In locating, take into account that tightening correctly will move the bearing further up the tapered sleeve. Do not tighten locknut beyond finger tight at this time.

6. Install Shaft Assembly - The shaft with bearing assemblies may be lowered into housing bases before or after tightening the bearings, depending on accessibility. Lower slowly and position bearings and seals to engage housing base. If bearing outer rings become misaligned do not force back into position. Instead, carefully work back by turning and sliding. Be sure that the inside of the housing is clean.

7. Tighten Bearings - Bearings must be mounted to achieve the required clearance removal.

a. Measure the initial built-in clearance across the top rollers by sliding the largest possible feeler gage between the rollers and outer ring raceway as shown in Figure 26, Page 23. A snug, or hard, feel is recommended. It must be possible to remove the shim by pulling it straight out.

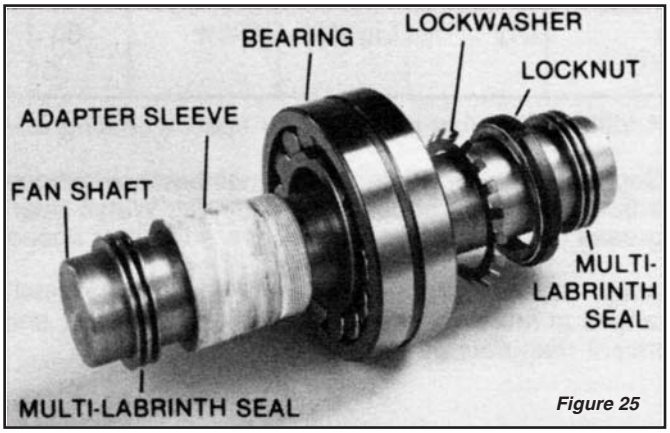


Figure 25

Table XI – BEARING CLEARANCE REDUCTION*

Shaft Diameter Range (in.)	Pillow Block Range	Bearing Range	Reduction of Clearance (in.)	
			Min.	Max.
1 7/16-1 3/4	6823-6828	22209LBK -22210LBK	.0010	.0012
1 15/16-2 3/16	6831-6835	22211LBK -22213LBK	.0012	.0016
2 7/16-2 11/16	6839-6843	22215LBK -22216LBK	.0016	.0020
2 15/16-3 1/2	6847-6856	22217LBK -22220LBK	.0018	.0024
3 11/16-4 3/16	6859-6867	22222LBK -22224LBK	.0020	.0028
4 7/16-5	6871-6880	22226LBK -22228LBK	.0026	.0035
5 3/16-5 7/16	6883-6887	22230LBK -22232LBK	.0030	.0039
5 15/16-6 1/2	6895-68104	22234LBK -22236LBK	.0031	.0043
6 15/16-7 3/16	68111-68115	22238LBK -22240LBK	.0035	.0051
7 1/2-8	68120-68128	22244LBK	.0039	.0055

*Clearance is measured between rollers and outer race after mounting and tightening adapter. Refer to Figure 26, Page 23

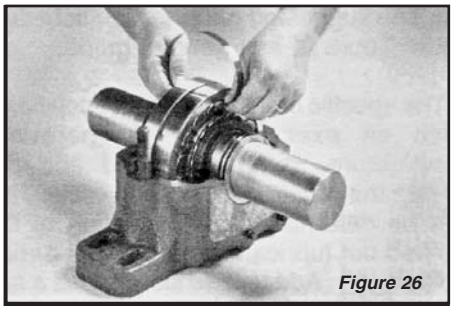


Figure 26

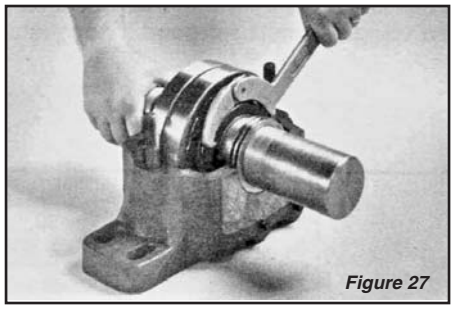


Figure 27

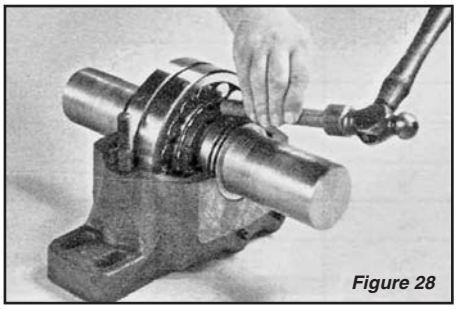


Figure 28

b. Tighten locknut forcing the bearing up the tapered O.D. of the sleeve until the bearing measured clearance is reduced by the amount shown in Table XI, Page 22. Follow tightening procedures in Step 8.

8. The preferred method of tightening for easy installation and for not damaging the bearing is illustrated in figures 27 and 28. Using a Spanner wrench, tighten the locknut until snug. Hold the adapter sleeve from turning until firmly seated. Using a soft steel bar and a hammer, drive against the face of the locknut as shown to relieve the thread pressure. Retighten the locknut and repeat until the correct adjustment specified in Step 7 is obtained. Where space limitations prohibit the above method, use a heavy-duty spanner wrench and stroke on its handle with a hammer so as to tighten the unit. This is more difficult and requires care to avoid damaging the lock washer, locknut and machined housing surfaces. With large units a combination of both methods can be successfully used.

9. Secure Locknut - Bend a tang of the lockwasher down into one of the locknut slots. Use the slot that is most nearly lined up with a tang. On larger units with a lockplate, engage the key of the lockplate in the adapter slot and bolt to the locknut. Use wire to lock bolts. Insert "C" spacer in fixed bearing housing, usually on locknut side.

10. Lubricate - Lubricate before operation. Consult the sections on grease or oil lubrication. Refer to Table X, Page 21.

11. Install Housing Cap - Apply non-hardening gasket compound to cap surfaces that contact the base (Especially for oil lubrication). Tighten cap nuts or bolts securely.

12 Complete Assembly – With the mounting bolts snug check alignment and freedom of rotation. The housing or shaft clearance at the seals is small and can be visually checked for uniformity all the way around.

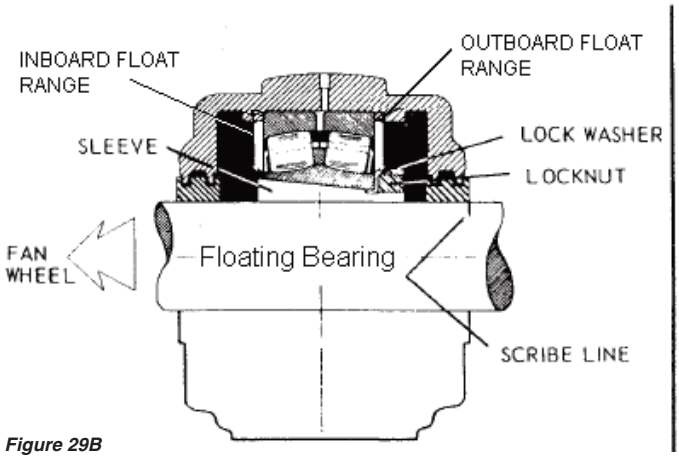
Align by shimming or shifting as necessary. Use large area shims to avoid distorting the housing and pinching the bearing. Appropriate use of stop bars against faces or ends of feet opposite the direction of load or vibration to avoid shifting of the housing is recommended. Dowel pins can be equally effective if properly used. This is especially important where loads are not directly down through the base. Finally, tighten or torque mounting bolts securely. Up to SAE Grade 5 mounting bolts can be used, properly torqued to mount cast iron housings. Up to SAE Grade 8 mounting bolts can be used, properly torqued, to mount cast steel housings.

GREASE LUBRICATION

Grease lubrication is recommended wherever conditions in Table X, Page 21 exist. For conditions that are not completely covered, consult Chicago Blower Corporation. The greases listed are for a general guide. A reputable lubricant manufacturer should be consulted to confirm the lubricant selection and application.

If bearings require oil instead of grease due to high tip speeds, temperature or high radial and axial thrust loads, see general assembly drawing bearing notes, and Tables VII and VIII on Page 19 and see Page 24.

Spherical Roller Adapter Bearing - Overhung Wheels



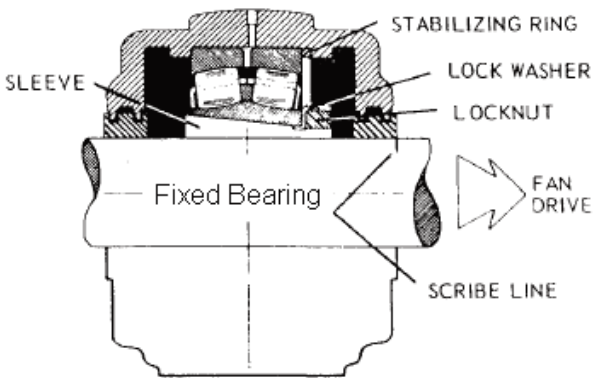


Figure 29B

OIL LUBRICATION

Oil Cup or Oil Bath Lubrication:

Oil cups can be applied to these units for use as a self-contained oil bath system. Oil bath lubrication is not recommended for speeds above the catalog oil speed limits, where excessive oil churning or misting occurs, or where there is air flow across the housing which will pull oil out through the seals due to differential pressures.

Oil levels are controlled by sight gages, oil cups, etc. These should be used in conjunction with a vent or breather cap. Proper static oil levels are shown in Table XII. Cups or sight gages should be carefully marked. See Figure 30.

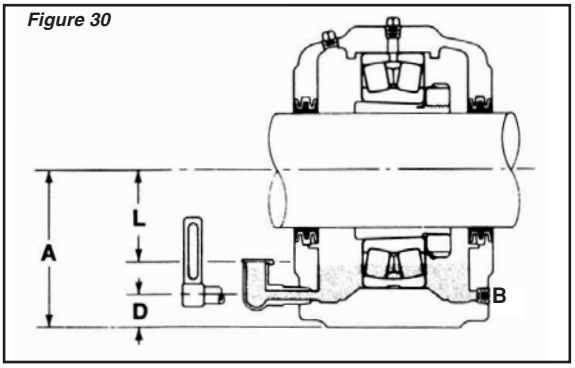
Circulating Oil Lubrication:

Oil circulation systems can be used under a wider variety or under more extreme operating conditions than any other lubrication method. They are especially valuable for high speed and high temperature service to provide better lubrication and cooler operation. A complete circulation system includes the use of pressure pump, a heat exchanger, or a method to cool oil, an adequate sump, a filter to remove particles over 20 micron in size and safety devices such as pressure and temperature warning devices and filter bypasses. See Figure 31. It is also best to tap oversized drain holes in the base or to provide a suction pump to positively remove oil from the housing. Oil should be removed from both sides of the housings, but where speeds are not high, one side is sufficient.

It is recommended that the circulation system have a separate motor so that the oil flow can be started in advance of bearing rotation. Experimentation with pressures, flow rates, temperatures and viscosity is often necessary to establish the best possible bearing lubrication.

Static Oil Dimension Guide

Figure 30



Oil Viscosity:

Required viscosity for good lubrication depends on starting temperatures, operating temperatures, and speed. The recomended viscosity level for bearings operating within catalog speed limits is between 100 and 150 Saybolt seconds (SSU) at bearing operating temperature for oil exit temperature on circulating systems. Slow speed, heavily loaded bearings require much higher viscosities.

Where starting temperatures are very low compared to operating temperatures, heaters may 'be necessary to provide oil flow in the lines or to provide adequate lubrication at start-up.

Maintenance and Lubrication:

Oil cup or bath systems require close attention because of the limited amount of oil in the system. Frequent changing of the oil in these systems is necessary to avoid lubricant breakdown.

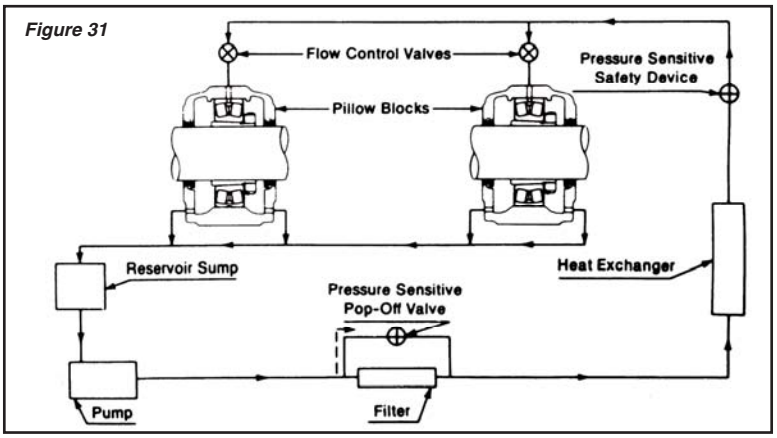
Oil circulation systems, properly equipped with safety devices require minimum attention after they are once satisfactorily adjusted. Frequency of changing the oil in the system depends upon the severity of the operation and size of the reservoir. In either case summer and winter grades may be necessary to stay within the recommended viscosity limits for good lubrication.

Table XII– STATIC OIL LEVEL (Dimensions in inches)

Bearing Size	A	B	Static Oil Level Below Bearing Centerline L	
			High	Low
1-7/16,1-1/2 1-11/16, 1/3/4 1-15/16, 2	2-1/4 2-1/2 2-3/4	7/16 9/16 9/16	1-9/32 1-3/8 1-17/32	1-3/8 1-15/32 1-5/8
2-3/16, 2-1/4 2-7/16 2-11/16	3 3-1/4 3-1/2	1/2 5/8 3/4	1-27/32 2-1/32 2-3/16	1-15/16 2-1/4 2-9/32
2-15/16, 3 3-3/16 3-7/16, 3-1/2	3-3/4 4 4-1/2	13/16 3/4 7/8	2-5/16 2-15/32 2-25/32	2-15/32 2-5/8 2-15/16
3-11/16, 3-15/16, 4 4-3/16 4-7/16, 4-1/2	4-15/16 5-1/4 6	7/8 1 1-1/4	3-1/16 3-5/16 3-9/16	3-7/32 3-1/2 3-3/4
4-15/16, 5 5-3/16 5-7/16	6 6-5/16 6-11/16	1-1/16 1-1/16 1	3-7/8 4-5/32 4-15/32	4-1/16 4-11/32 4-21/32
5-15/16, 6 6-7/16 6-15/16, 7	7-1/16 7-1/2 7-7/8	1-1/8 1-1/8 1-1/4	4-3/4 4-31/32 5-1/4	4-15/16 5-5/32 5-7/16
7-3/16 7-1/2, 7-15/16, 8	8-1/4 9-1/2	1-3/8 2-1/2	5-9/16 6-5/32	5-3/4 6-11/32

Schematic Diagram of Circulating Oil System

Figure 31



INSTALLATION RECORD
FAN WARRANTY

Job Site _____ System _____
Fan Size _____ Chicago Blower Fan Serial No. _____
Design _____ Class _____ Fan Assembly Drawing No. _____
Fan Rated CFM _____ Fan Rated Static Pressure _____ Fan Rated BHP _____
Maximum Operating Temperature _____°F. Fan Maximum Operating Speed _____
Size Bearings_____ Type _____ Manufacturer _____
Size Coupling _____ Type _____ Manufacturer _____
Motor HP _____ RPM _____ Frame Size _____Manufacturer _____
Date Fan Shipped _____ Date Installation Completed _____ Date Fan Start _____
Name of CBC Service Engineer _____ Name Millwright in Charge _____
Fan Purchased From _____ Installing Contractor _____
Chicago Blower Local Sales Office _____ Phone _____

WARRANTY

Chicago Blower warrants products of its manufacture to be free of defects in material and workmanship for a period of one year from the date of original shipment. This warranty is subject to the following terms and limitations:

(1) All products must be properly installed, cared for and operated under normal conditions and with adequate supervision.

(2) Chicago Blower will not be liable or responsible for (i) any corrosion or fouling caused by any foreign substances, or (ii) any defects caused by adjustments, alterations or repairs made or attempted outside of Chicago Blower's factory, except upon the prior written consent of Chicago Blower.

(3) Since no currently known form of construction, material, alloy or coating will successfully resist all abrasion, erosion, corrosion, or deterioration from excessive heat or vibration, this warranty does not extend to any damage or defect caused by any of those conditions.

(4) Research undertaken by the Air Movement and Control Association, Inc. in cooperation with test code committees of the engineering societies reveals thus far that no practical method exists for testing the suitability of fans in a specific system. CHICAGO BLOWER THEREFORE DOES NOT WARRANT AND SPECIFICALLY EXCLUDES ANY WARRANTY THAT ITS PRODUCTS ARE FIT FOR A PARTICULAR PURPOSE OR USE. Responsibility for determining the fitness of our products for intended use is the purchaser's.

(5) The sound power and pressure data contained in Chicago Blower quotations are for a hemispherical free field condition and comply with AMCA Standard 301, Method for Publishing Sound Ratings, and are the result of tests made in accordance with AMCA Standard 300, Test Code for Sound Rating air moving devices. The data is in no way to be construed as a guarantee in that the industry has not found a practical and accurate method of verifying individual equipment sound levels by field testing.

(6) CHICAGO BLOWER DOES NOT PROVIDE ANY WARRANTY (EXPRESS OR IMPLIED) WITH RESPECT TO COMPONENT PARTS (MOTORS, SWITCHES, CONTROLS OR ACCESSORIES) WHICH ARE MANUFACTURED BY OTHERS. However, these products are usually warranted separately by their respective manufacturers.

(7) CHICAGO BLOWER DOES NOT WARRANT ITS PRODUCTS TO BE IN COMPLIANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT ("OSHA") AS AMENDED OR ANY REGULATIONS THEREUNDER. Compliance with OSHA is the exclusive responsibility of the user of the equipment.

(8) ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY EXCLUDED.

(9) This warranty may not be modified except by written agreement signed by an officer of Chicago Blower Corporation.

LIMITATION OF LIABILITY

Chicago Blower's liability for any purpose is limited to repairing or replacing at its factory any defective part or parts which shall, within one year after original shipment, be returned to its factory, transportation charges prepaid. Repair or replacement of defective parts shall be the purchaser's sole and exclusive remedy. Under no circumstances will Chicago Blower be liable for any injury to persons or property, nor will Chicago Blower be liable for any damages of any kind, whether incidental, consequential or otherwise, whether arising out of breach of contract, breach of warranty, tort liability, strict liability or otherwise. If the goods, however, prove to be so defective as to preclude remedying the defect by repair or replacement, the purchaser's sole and exclusive remedy and Chicago Blower's sole and exclusive liability will be refund of the purchase price. Purchaser will defend, indemnify and hold Chicago Blower harmless against any claims for liability or damages which are made against Chicago Blower and which are directly or indirectly related to Chicago Blower's sale of products to purchaser.

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